United States Department of the Interior

FISH AND WILDLIFE SERVICE

Virginia Field Office
6669 Short Lane
Gloucester, VA 23061

June 7, 2019

Ms. Shari Miller
Lead, Environmental Planning
Code 250.W
Wallops Flight Facility
Wallops Island, VA 23337

Re: Wallops Flight Facility Update and Consolidation of Existing Biological Opinions, Accomack County, VA, Project # 2015-F-3317

Dear Ms. Miller:

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion (Opinion) based on our review of the referenced project and its effects on the federally listed threatened piping plover (*Charadrius melodus*) (plover), red knot (*Calidris canutus rufa*) (knot), and loggerhead sea turtle (*Caretta caretta*) Northwest Atlantic Ocean distinct population segment (DPS) (loggerhead), in accordance with section 7 of the Endangered Species Act (16 U.S.C. 1531-1544, 87 Stat. 884), as amended (ESA). Your request to reinitiate formal consultation was received on December 18, 2018.

This Opinion is based on information provided in the National Aeronautics and Space Administration's (NASA) December 14, 2018 Shoreline Enhancement and Restoration Project (SERP) biological evaluation (BE); December 7, 2018 Draft NASA Wallops Flight Facility (WFF) SERP Environmental Assessment (EA); telephone conversations; field investigations; and other sources of information. The consultation history is located after the Literature Cited. A complete administrative record of this consultation is on file in this office.

This Opinion expires 15 years from the date of signature.

We concur with the NASA determination that the federally listed threatened northern long-eared bat (*Myotis septentrionalis*) is not likely to be adversely affected by the proposed action with the application of the proposed avoidance and minimization measures in the August 18, 2015 reinitiation and consolidation request letter are followed, with the exception of the removal of identified roost trees. If identified roost trees are proposed for removal at any time, additional consultation may be required on a project-by-project basis. The northern long-eared bat will not be considered further in this Opinion.

The BE included a request for Service concurrence with "not likely to adversely affect" determinations for certain listed resources. NASA determined the proposed action is not likely to adversely affect the federally listed endangered roseate tern (*Sterna dougalii dougalii*), hawksbill sea turtle (*Eretmochelys imbricata*), leatherback sea turtle (*Dermochelys coriacea*), and Kemp's ridley sea turtle (*Lepidechelys kempii*), and federally listed threatened green sea turtle (*Chelonia mydas*) North Atlantic DPS or seabeach amaranth (*Amaranthus pumilius*). We concur with your determination because the species are unlikely to be present or have not been identified in the area during annual monitoring.

BIOLOGICAL OPINION

DESCRIPTION OF PROPOSED ACTION

As defined in the ESA section 7 regulations (50 CFR 402.02), "action" means "all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies in the United States or upon the high seas."

This Opinion serves 2 purposes: (1) provide an Opinion on the proposed SERP and (2) consolidate activities described in the 2016 Wallops Flight Facility Update and Consolidation of Existing Biological Opinions (Service 2016), that have not have changed, into a single Opinion. The following is a summary of the activities that are part of the proposed action requiring reinitiation. All other activities described the Service's 2016 Opinion will remain the same. For ease of reference and readability, information from the Service's 2016 Opinion is provided without edits throughout most of this document, but in some places has been edited for consistency with the actions resulting in reinitiation.

A detailed description of the proposed activities requiring reinitiation can be found in the 2010 Final Shoreline Restoration and Infrastructure Protection Program (SRIPP) Programmatic Environmental Impact Statement (renourishment component of Alternative 1), reexamined in the 2013 Final Post-Hurricane Sandy EA, and described in the SERP EA and SERP BE. NASA is funding the excavation, or "backpass," of approximately 1.3 million cubic yards (MCY) of sand sourced from the north Wallops Island beach to renourish and restore approximately 19,000 linear feet (ft) of shoreline. Additionally, NASA is funding construction of a series of parallel breakwaters approximately 200 ft offshore from the renourished shoreline.

To minimize impacts to knots, plovers, and loggerheads, sand excavation on north Wallops Island will not begin until after the last plover chick has fledged or the last loggerhead has hatched, whichever is later. Sand will continue to be excavated, transported south, and used to renourish the south and mid-island until the fill design template has been met (1.3. MCY of sand has been excavated and redistributed). Work is anticipated to take 6-9 months to complete and depending on the start date, the work may overlap with the arrival and/or nesting of the species in the following year. NASA is planning to renourish every 2-7 years, but the use of backpassing for renourishment is not expected for another 10 years and an offshore shoal will be used for interim renourishments.

Starting March 15 of each year, a biological monitor will conduct a daily survey of the whole of Wallops Island beach for nesting plovers and sea turtles. Any nests discovered will be immediately exclosed and geolocated. The biological monitor will coordinate directly with onsite project personnel to ensure they are aware of nesting status and the need to suspend work activities within 1,000 ft of a nest until chicks have fledged and/or sea turtles have hatched.

Establishment of upland areas for equipment and material staging will be discussed with the contractor may be discussed daily, depending on where they are working.

Proposed SERP Activities

<u>Backpassing</u> – The borrow area will be located on NASA property on the northern end of Wallops Island. During excavation, a pan excavator will remove sand from approximately 200 acres (ac) of north Wallops Island beach to the mean low water (MLW) line (Figure 1). The average excavation depth will be 2.35 ft. Sand excavation will impact approximately 169 ac of land above mean high water (MHW), and 31 ac of land seaward of MHW to provide the required volume for the proposed renourishment. Sand will be loaded onto dump trucks for transport to the southern end of the island and will be stockpiled on the southern end once enough beach has been built to accommodate the sand. Trucks will use existing access roads to gain entry to the beach and no new roads will be constructed.

Figure 1. Proposed borrow area, North Wallops Island beach.

Renourishment – Bulldozers will be used to spread the fill material once it is placed on the beach. All heavy equipment will access the beach from existing roads and established access points. No new temporary or permanent roads will be constructed to access the beach or to transport the fill material to renourishment areas. The beach fill will start approximately 1,500 ft north of the Wallops Island-Assawoman Island property boundary and extend north for approximately 3.7 miles (mi) (Figure 2 and 3). The initial fill will be placed to construct a 6 ft high berm extending a minimum of 70 ft seaward of the existing seawall. Remaining fill will slope seaward at varying distances along the length of the renourishment area. Beach renourishment activities may occur year-round. American beach grass (*Ammophila breviligulata*, cultivar "Cape") will be planted at 18 inch (in) intervals over the re-established dune. Plants will be installed between October 1 and March 31. The planting area will be approximately 150 ft wide along the entire length of the newly created dune in the beach renourishment area.

Figure 2. Proposed renourishment area.

Breakwaters – Six rubble mound breakwaters will be constructed in 2 sets of 3, each approximately 200 ft offshore from the MHW line of the renourished beach in the shoreline infrastructure protection area (Figures 3 and 4). Water depth in these areas is approximately 4-8 ft. Each breakwater will be constructed of Virginia Department of Transportation Type I armor stone (1,500-4,000 pounds [lbs]) for the outer layer and Class II Stone (150-499 lbs) for the core layer. All breakwaters will be placed parallel to the shore and measure approximately 130 ft long and 10 ft wide at top crest elevation. The breakwaters will be approximately 100 ft apart from each other. The southernmost set of 3 breakwaters will begin approximately 4,000 ft north of the southern extent of beach nourishment. The second set of 3 breakwaters will be constructed approximately 10,000 ft north of the southern extent of beach nourishment. The rocks for constructing each breakwater may be transported to the WFF area by barge and placed in the water using heavy lifting equipment.

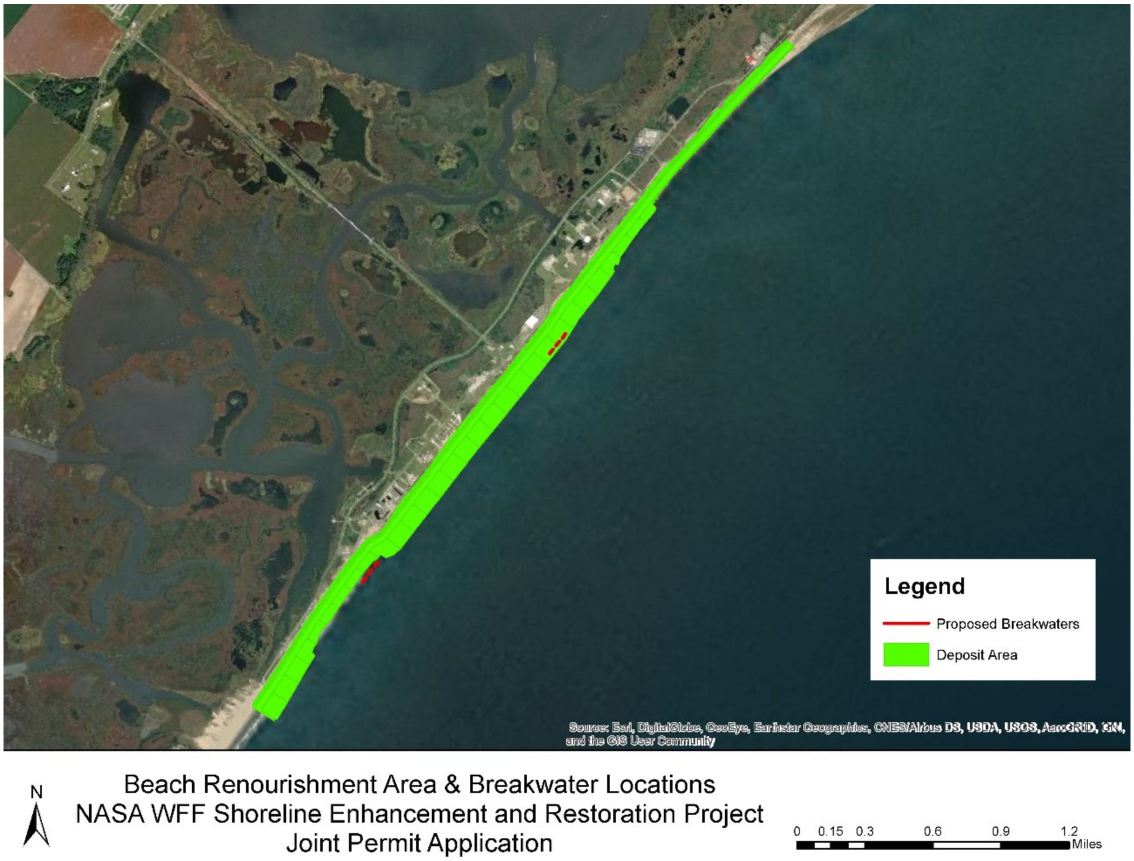

Figure 3. Breakwater and renourishment area overlap.

Figure 4. Breakwater locations.

Activities remaining unchanged from Service's 2016 Opinion are summarized in Table 1 and detailed below. The action of Beach Renourishment and Long-term Project Maintenance includes some activities that remain unchanged, described in subsequent paragraphs, while the altered activities have been described in earlier paragraphs in this Opinion.

Table 1. Ongoing launch operations and SRIPP at WFF.

Action	Location	Frequency	Time of Year	Time of Day
Liquid Fueled Expendable Launch Vehicle (ELV) Launches	Pad 0-A	6/year	Year-round	Either
Solid Fueled ELV launches	Pad 0-B	12/year	Year-round	Either
ELV Static Fires	Pad 0-A	2/year	Year-round	Either
Sounding Rocket Launches	Current: Pad 1 and Pad 2 Future: Pad 2 and south Unmanned Aircraft System (UAS) airstrip flat pad	60/year	Year-round	Either
Sounding Rocket Static Fires	Pad 2	33.5 tons double base & 38.3 tons composite propellants/12-month period	Year-round	Either
Disposal of Defective or Waste Rocket Motors	Open Burn Area, south Wallops Island		Year-round	Either
Drone Target Launches	Pad 1, 2, 3 or 4	30/year	Year-round	Either

UAS Flights	Wallops Main Base, South Wallops Island, North Wallops Island	75 missions/week	Year-round	Either
Piloted Aircraft Flights	Wallops Main Base and adjacent airspace	61,100 operations/year	Year-round	Either
Restricted Airspace Expansion	Main Base, Wallops Island, and adjoining airspace	No change in type or tempo or aircraft activity	Year-round	Either
Range Surveillance/Facility Security	Wallops Island	N/A	Year-round	Either
Construction	Wallops Island	N/A	Year-round	Either
Routine Facility Maintenance	Wallops Main Base, Wallops Island	As needed	Year-round	Day
Launch Pad Lighting	Wallops Island	30 days/launch	Year-round	Night
Recreational/ Off-road Vehicle (ORV) Beach Use	Wallops Island	N/A	Year-round	Day
Protected Species Management	Wallops Island	N/A	Spring and Summer	Day
Miscellaneous Activities on Wallops Island Beach	Wallops Island	As needed	Year-round	Day
Education Use of Wallops Island Beach	Wallops Island	Several trips/week	Year-round	Day
Seawall Repair	Wallops Island	As needed	Year-round	Day
Shoreline Reconstruction Monitoring	Wallops Island	2/year	August – October and March-May	Day
Beach Renourishment and Long-term Project Maintenance	Wallops Island	Every 2-7 years	Year-round	Day

Ongoing Launch Operation Activities

<u>Liquid and Solid Fueled ELV Launches and Static Fires</u> – ELVs are launched from Launch Complex 0 at the south end of Wallops Island, between the southernmost extent of the sea wall and the UAS runway. Pad 0-B is topped with a permanent gantry. A transporter erector launcher raises and launches rockets from Pad 0-A. Both launch pads are illuminated with broad spectrum night lighting for up to several weeks on either side of the launch window; effectively resulting in up to 30 calendar days of night lighting per launch event. Exhaust ports on each launch pad direct rocket motor exhaust to the east, across a narrow strip of steep sandy beach and over the Atlantic Ocean. Launches from either pad may occur at any time of day, on any day of the year, as dictated by weather conditions and program needs.

Rockets launched from Pad 0-B use solid fuel systems based on an ammonium perchlorate/aluminum (AP/AL) or nitrocellulose/nitroglycerine (NC/NG) combination. Many classes of rockets may be launched from this site, the largest of which will be equivalent to the LMLV-3(8). Rockets launched from Pad 0-A will use liquid fuel systems with refined petroleum or liquid methane and liquid oxygen as propellants, thus requiring liquid nitrogen prior to launch for cooling the propellants, and gaseous helium and nitrogen as pressurants and purge gases. The largest vehicle proposed to launch from Pad 0-A will be Orbital ATK's Antares 200 Configuration ELV. Orbital rockets deliver spacecraft into orbit that may utilize hypergolic propellants.

The Antares 200 Configuration ELV employs 2 NPO Energomash provided RD-181 engines, which also use liquid oxygen and refined petroleum as propellants. These motors will be more powerful (up to 17 percent more thrust at sea level) than the previous AJ-26 engines and consequently will allow for a heavier payload to be placed into orbit. The Antares 200 Configuration also utilizes modifications to valves and piping in the first stage fuel feed system, modifications to structural and thermal components in the first stage, and changes to avionics and wiring, and requires slightly different ground support equipment (used to handle and test rocket components) and fueling infrastructure. The Antares 200 Configuration will be launched from Pad 0-A, with up to 6 launches per year, and 2 static test fires per year.

Sounding Rocket Launches – Sounding rockets are currently launched from 2 launch pads in the vicinity of Launch Pad 1 and 2. In the future, sounding rockets will be launched from 2 launch pads in the vicinity of Launch Pad 2 and the south UAS airstrip flat pad. These launch pads are topped with mobile shroud sheds rather than gantries, and temporary rail launchers are used to orient the rockets for launch. Sounding rockets do not have a long loiter time on the launch pad after ignition, therefore these launch pads are not equipped with exhaust ports. Many classes of sounding rockets are used at these sites, the largest of which is the Black Brant XII burning 3,350 kilograms (kg) of solid propellant. Propellants used are based on an AP/AL or NC/NG combination. Sounding rockets do not deliver spacecraft into orbit, and therefore do not carry hypergolic propellants. As many as 60 sounding rockets are launched per year, at any time of day, on any day of the year, as dictated by weather conditions and mission needs.

Sounding Rocket Motor Static Fire Testing – NASA performs sounding rocket motor static fire tests so that motor operations can be observed in a non-flight position. Rocket motors may be static test fired from either a horizontal or vertical position. WFF has been authorized by the Virginia Department of Environmental Quality Air Division to perform static fire tests on solid propellant sounding rocket motors from Pad 2. The envelopes for static fire tests are governed by the limits set forth in the Wallops Island State operating permit. Exhaust from static test firings will be directed through a trench and over the Atlantic Ocean. The deluge system used for orbital launches from Pad 0-A will be used to cool the launch pad and dampen vibration during static firing tests. Sounding rocket motor static fire testing encompasses 33.5 tons of double base and 38.3 tons of composite propellants over a 12-month period.

Disposal of Defective or Waste Rocket Motors – Defective or waste rocket motors are ignited at the open burn area south of the UAS runway on the south end of Wallops Island. Motors that cannot be returned to the manufacturer or repurposed for other projects are placed on a concrete pad or bolted to a subunit and ignited to burn off any stored propellant. Multiple motors can be consolidated into a single burn. Ash remaining after a burn is burned again or shipped off-site for disposal. The remaining motor casings are steam cleaned and disposed of as scrap metal. The water used for steam cleaning is captured and tested for toxins before disposal under a Virginia Department of Environmental Quality permit. The maximum amount of propellant to be disposed of per year at the open burn area for sounding rocket static fires and disposal of defective or waste rocket motors is 33.5 tons double base and 38.3 tons composite propellants. Burns are infrequent and have not approached the disposal permit limit.

Drone Target Launches – Drone targets are launched from WFF or air launched from military aircraft in support of U.S. Navy (Navy) missile training exercises. These targets use a variety of fuels, including liquids such as JP-5 jet fuel or hydrazine derivatives, or solid fuels such as AP/AL or NC/NG. Drones travel on preprogrammed flight paths and are engaged by shipboard interceptor systems over the Virginia Capes Operating Area (VACAPES OPAREA), with all debris from the intercept falling within the VACAPES OPAREA boundary. Drone flights may occur at any time of day, on any day of the year, as dictated by training needs and may occur up to 30 times per year.

UAS Flights – UAS are used at WFF in support of scientific missions. UAS flights may use the UAS runway on the south end of Wallops Island, between Pad 0-B and the open burn area, as well as the runways on the Main Base. The largest anticipated UAS that may be flown from the WFF Main Base runways will have engines and fuel capacity one-fifth those of a Boeing 757, though most are considerably smaller.

A new UAS airstrip is planned for construction on the north end of Wallops Island. When this airstrip is operational, the south Wallops Island airstrip will be decommissioned. UAS flown from the North Wallops Island UAS airstrip cannot exceed the noise generated by the Viking 300 or the size (in terms of physical size and quantities of onboard materials) of the Viking 400 (NASA 2012a). UAS operations are projected to occur at a frequency of 75 missions per week and will not exceed 1,040 sorties per year.

Piloted Aircraft Operations – Piloted aircraft use the runways on WFF Main Base. Aircraft using the runways range from small single propeller designs up to the Boeing 747, and include such military designs as the F-16 and F-18. Many of the airfield operations conducted at WFF include military pilot proficiency training that consists primarily of "touch-and-go" exercises in which the aircraft wheels touch down on the airstrip but the aircraft does not come to a complete stop. The U.S. Air Force, Air National Guard, U.S. Army, U.S. Coast Guard, and Navy conduct pilot proficiency training at WFF runways.

An airfield operation represents the single movement or individual portion of a flight in the WFF airfield airspace environment, such as 1 takeoff, 1 landing, or 1 transit of the airport traffic area. The baseline airfield operation level for WFF of 12,843 was established in 2004 using annual airfield operations data for that year with an envelope that included a 25 percent increase above the total. Since 2013, WFF's piloted aircraft operating envelope was increased to include an additional 45,000 operations. The current operating envelope is limited to 61,000 operations per year. Air traffic from Wallops Main Base flies over Wallops Island.

Restricted Airspace Expansion – NASA has requested the Federal Aviation Administration (FAA) grant additional Restricted Airspace such that NASA can conduct experimental aircraft test profiles with a lower risk of encountering non-participating aircraft. No changes are proposed to either the types of aircraft or the types and number of operations conducted within the airspace adjacent to WFF. Consistent with existing practices, aircraft operating within the new restricted airspace will be required to maintain at least a 2,000 ft altitude when operating above the Service's Chincoteague National Wildlife Refuge (CNWR).

Range Surveillance/Facility Security – In general, UH-1 helicopter surveillance flights occur twice per launch countdown and range in altitude from 200 ft above ground level (AGL) to 5,000 ft AGL. Each flight is approximately 2.5 hours in duration, with the helicopter's primary surveillance responsibility being the lagoon area between Wallops Island and the mainland Eastern Shore of Virginia; however, flights can range up to 1.15 mi offshore.

Contracted fixed wing radar surveillance aircraft operate the majority of the time at 15,000 ft AGL and remain within the VACAPES OPAREA airspace. Fixed wing spotter aircraft operate in the same area but their altitude varies between 500 ft and 15,000 ft AGL. The spotters spend less than 10% of their flight time below 1,500 ft; only descending to low altitudes to visually obtain a call sign from an intruding boat or get the attention of the crew. Most of the spotters fly for around 4 hours total; the radar planes fly between 4 and 5.5 hours per mission. A typical ELV mission requires 1-2 fixed wing surveillance aircraft.

Surface surveillance and law enforcement vessels can include up to 8 inboard- or outboard-powered boats, up to approximately 43 ft in length. Generally, the larger inboard vessels range between 10 and 12 knots (kt) cruising speed, whereas the small inboard vessels cruise between approximately 25 and 30 kt.

Navy and NASA facilities on Wallops Island are equipped with exterior lights at ground level, along catwalks, and at FAA mandated heights for aircraft orienteering. Security of facilities on Wallops Island is maintained by a private contractor. Individuals on foot or in vehicles tour the perimeter of Wallops Island, including the beach areas on the north and south end of the island. These patrols may be performed as often as deemed necessary to maintain base security. Security may transition from the current system of frequent roving patrols to a closed circuit television system. If the closed circuit surveillance system is installed, security officer beach access will be reduced to the minimum required to augment the cameras in providing facility security.

Construction – NASA is currently relocating the Wallops Island fire station adjacent to Navy Building V-024. Consistent with the external lighting employed on the Horizontal Integration Facility and Pad 0-A, the new fire station will employ long wavelength exterior lighting to reduce potential effects on nesting loggerheads and their hatchlings (Witherington and Martin 2003).

Routine Facility Maintenance – The operation of WFF requires continuing routine repairs and ongoing maintenance of buildings, grounds, equipment, aircraft, vehicles, laboratory equipment, and instrumentation. Existing infrastructure, such as roads and utilities are maintained on a regular basis to ensure their safety and operational capacity. Existing buildings also require ongoing maintenance. Buildings or utility systems may be rehabilitated or upgraded to meet specific project needs. Brush and trees may be removed to construct a new building, keep the airfield's clear airspace free of intrusions, maintain the facility's perimeter fence, manage wildlife, maintain radar and tower line of sight, or enhance operation of other radio frequency equipment. Routine repairs are often required after hurricanes or intense storms. NASA contractors use heavy equipment to clear roads and stormwater systems.

The boat dock at the north end of Wallops Island receives equipment such as rocket components that cannot be delivered to the island by truck. The existing access channel and boat basin will be maintained via dredging to a depth of 4 ft at low tide to accommodate deliveries at any time of day.

Launch Pad Lighting – During orbital and suborbital launch operations, bright, broad-spectrum area lighting is required. Observations of operations at both Pads 0-A and 0-B have shown that broad spectrum night lighting can be required for up to several weeks on either side of the launch window, effectively resulting in up to 30 calendar days of night lighting per launch event. During non-critical operations, the launch pad area will be illuminated by a combination of amber light emitting diode and low pressure sodium fixtures.

Recreational/ORV Beach Use – WFF personnel and their families are allowed to use the north end of Wallops Island for recreation outside of NASA operations periods. Recreational use may involve operation of vehicles on the beach, in addition to foot traffic. Users access the beach by the north Wallops Island ORV access. Beach access is year-round and is not expected to increase in frequency from the level previously considered. The northernmost extent of Wallops Island beach is closed to all recreational use from March 16 through August 31, or until the last plover chicks fledge (see Figure 10). The south end of Wallops Island is closed to recreational use year-round.

Protected Species Management – In accordance with its Protected Species Management Plan (NASA 2015a), NASA will continue to monitor Wallops Island beach for beach nesting species activity. Protected species management activities involve conducting frequent monitoring surveys, implementing area closures and posting signage, placing plover nest exclosures, and similar actions. Additional protective measures, including employee education, seasonal closure of the northernmost extent of Wallops Island beach, nest exclosures, and predator management will continue.

Miscellaneous Shoreline Activities – Occasional shoreline debris (biotic and abiotic) removal is necessary within all areas of Wallops Island beach. For example, if a large tree limb is deposited on the shoreline during a storm, it will be removed. Likewise, following rocket launches from Launch Complex 0, particularly Pad 0-B, miscellaneous metallic and non-metallic debris is often deposited on the nearby shoreline. Similarly, these items will be removed. While in recent years such debris could be reasonably removed by hand, it is possible that in certain cases mechanized equipment will be required to extract a partially buried or heavy item. Finally, there could be instances where mechanized equipment will be necessary within this area to conduct miscellaneous activities that do not relate to typical beach debris removal or periodic renourishment activities. An example of such an instance occurred in July 2013, when a deceased juvenile humpback whale (*Megaptera novaeangliae*) was buried on the north Wallops Island beach; requiring use of a backhoe. Debris removal is only scheduled during off-season unless there is a rocket accident or some other emergency. For any operation that occurs during nesting season, whether debris removal or another operation, nest locations are always translated to the cognizant Program Manager and the WFF Safety Office.

Educational Use of Wallops Island Beach – Students affiliated with NASA and the Chincoteague Bay Field Station of the Marine Science Consortium education programs regularly use Wallops Island beach for field trips and related activities. Such use of the beach occurs year-round with activity levels peaking during the summer months. Groups range in size from 5-20 students. These groups access the beach by either the north Wallops Island ORV access or the path east of the Island helicopter pad. Groups may only access the beach on-foot and must be under the supervision of a trained faculty or staff member.

Proposed and Ongoing Shoreline Restoration and Beach Renourishment Activities

The SRIPP is intended to use a multi-tiered approach to reduce damages to Wallops Island facilities from ongoing beach erosion and storm wave damage incurred during normal coastal storms including tropical systems and nor'easters. NASA has identified the SRIPP's design target performance of providing significant defense against a 100-year return interval storm with respect to storm surge and waves. The performance is provided by a combination of the reconstruction of a beach, berm, and dune that will help to absorb and dissipate wave energy before it nears NASA infrastructure, and a rock seawall embedded within the dune that will protect against the most severe energy. For these features to provide reliable protection for the SRIPP's design lifetime of 50 years, the beach must be maintained routinely throughout 50 year lifetime. The shoreline on the southern end of Wallops Island has been retreating at a rate of approximately 10 ft per year as a result of erosion (U.S. Army Corps of Engineers [Corps] 2010).

Seawall Repair – A seawall composed of large rock is currently located along 15,900 ft of the Wallops Island shoreline. This seawall was built in 1992 and protects WFF infrastructure within the northern portion of the eroding shoreline from damage due to storms and large waves. The wall has prevented overwash and storm damage, but erosion of the shoreline seaward of the wall has continued, resulting in an increased risk of damage to the seawall. NASA may repair and extend the existing rock seawall up to an additional 4,600 ft. Additional maintenance of the existing seawall may include operation of heavy equipment and placing or replacing dirt and/or rock in previously disturbed areas behind the seawall to maintain and augment the function of the existing seawall and protection resulting from these features.

In conjunction with construction activities, qualified biologists will continue to regularly survey the beaches in the vicinity of the project for use by sea turtles, plovers, and other species. If nesting activity of protected species is recorded, NASA will avoid work in areas where nesting occurs and/or implement other appropriate mitigation measures.

Shoreline Reconstruction Monitoring – As part of the SRIPP, NASA is conducting a shoreline monitoring program to record and document changes in shoreline characteristics over time as the project is subjected to normal weathering and storm events. The monitoring effort began prior to construction of the seawall, beach, and dune to establish a baseline condition and record any changes that occur between design and implementation.

A monitoring survey of the shoreline in the vicinity of Wallops Island is conducted twice a year. The first monitoring event is conducted along the entire length of Wallops and Assawoman Islands, a distance of approximately 8.5 miles. The second monitoring event is limited to the length of shoreline from Chincoteague Inlet south to the former Assawoman Inlet, which defines the south end of Wallops Island. In the cross-shore direction, elevation data is collected from behind the dune line to seaward of the depth of closure (the eastern edge of the underwater fill profile), estimated to be at approximately -15 to -20 ft below MLW. Near Chincoteague Inlet the ebb shoal complex creates a large shallow offshore area; therefore, surveys in this area extend a maximum of 2 miles offshore if the depth of closure is not reached. These surveys will be repeated annually once at the end of summer (August to October) and once at the end of winter (March to May).

Cross-sections of the beach have been taken along new and/or previously established baselines on set stations every 500 ft from Chincoteague Inlet to Assawoman Inlet and every 1,000 ft from Assawoman Inlet to Gargathy Inlet. The beach surveys extend from the baseline to a depth of -4 ft below MLW offshore. An offshore hydrographic survey along the previously established baseline on set stations every 500 ft was conducted. The offshore survey extended from -3 ft below MLW to the depth of closure, anticipated to be between -15 to -20 ft below MLW. The hydrographic survey was conducted within 2 weeks of the beach survey. Light Detection and Ranging data will continue to be obtained for the monitoring area approximately once a year. Both horizontal and vertical survey datum will be obtained. The survey of the beach, surf zone, and offshore area, will document changes in the Wallops Island shoreline in addition to areas adjacent to Wallops Island. The results of these monitoring efforts are being used to measure shoreline changes to evaluate the performance of the project, potential impacts to resources, and to aid in planning renourishment when needed to ensure continued project function.

Beach Renourishment and Long-Term Project Maintenance – To maintain a beach and dune at a fixed location in a condition to effectively buffer wave energy, NASA plans beach renourishment cycles throughout the 50-year life of the SRIPP as determined by the proposed monitoring program. The location, extent, and magnitude of renourishment events may vary significantly as a result of the frequency and severity of storm activity and subsequent shoreline erosion. The availability of funding, logistical constraints, and other issues may also affect the implementation of renourishment. Even if renourishment is needed based on the modeled project performance and intent, NASA may choose to forego or delay renourishment because the project will retain most of its intended and designed storm protection function even if renourishment is not implemented as envisioned in the Programmatic Environmental Impact Statement (NASA 2010a).

The projected renourishment frequency and amounts are based on the modeled average rates of sand loss, with models based on the historic meteorological conditions recorded at and near the project area. Based on available modeling of project performance over time, the SRIPP identified an expected renourishment frequency of approximately every 5 years for the 50-year life of the project, but which may be as frequent as every 2 years or may be delayed to every 7 years. Based on the general characterization of function, the SRIPP estimates that each renourishment cycle will require approximately 806,000 cubic yards ($yd^{3)}$ of sand placed on the beach in each of the 9 renourishment events, for a total expected renourishment volume of 7,254,000 yd^3 of sand over the life of the project, excluding the amount required for the initial beach and dune reconstruction.

If future renourishments use sand of smaller grain size or reduced quality, more frequent renourishment or larger volumes of sand may be required. The last two sand renourishments were from the offshore shoal, and the grain size on the island is identical to those of the shoal. However, testing has shown variation in grain size based on sand source, so there is potential for differences in grain size during future renourishments (NASA 2010a, see table 6). If there are changes in the pattern of sand movement along the shoreline, such as reduced southerly transport over time, renourishment may be needed less frequently. In the Programmatic Environmental Impact Statement, NASA considers the addition of breakwaters or groins as the addition of these features may result in reduced sand requirements, however groins are not evaluated in the proposed action.

The Wallops Island shoreline will experience effects of future sea level rise, and this has been anticipated by providing an additional sediment volume during each renourishment event that will raise the level of the entire beach fill by an amount necessary to keep pace with the projected rise rate (Corps 2010). Applying the Corps' standard sea level rise equation based on local measurements to a 50-year project at Wallops Island yields sea level elevations between 0.84 ft and 2.53 ft above present levels. For project planning purposes, a target fill volume 85 percent of the upper estimates of the amount needed to match the 50-year projected sea level rise was selected, but the SRIPP includes adding that volume in constant increments over time instead of in a pattern that will match anticipated increases. This means that in the early years of the project the amount of fill being added will exceed the amount necessary to match the expected amount with the crossover point being in the 28th year (2038) of the project. This way, the sea level fill volume could be increased, if needed, during later renourishment events. The sea level rise volume, which is an additional amount added during each renourishment event (assuming a 5-year interval between events), is 112,000 yd^3. Deviations from existing modeled or projected sea level rise scenarios may change the amount of sand needed for renourishment.

The number of uncertainties included in the projections resulting from the modeling, model assumptions, limitations of the records of past meteorological and climatological measurements in the area, current understanding of meteorological and climatic patterns, and future decisions of NASA and other agencies are likely to result in deviations from the projected renourishment.

Sources of Sand for Renourishment – Three borrow sites have been identified as sources for potential future beach renourishment: the on-shore north Wallops Island borrow area, unnamed shoal A, and unnamed shoal B (located east of shoal A). All of these sites have been determined to be consistent with the project purpose and suitable, but all have different costs and concerns associated with their use that must be evaluated prior to use in each proposed future renourishment. The on-shore north Wallops Island borrow area was described earlier in the description of the action (also see Figure 1).

Unnamed shoal A, the source of sand for the initial reconstruction, may be used as the source for renourishment. The shoal covers an area of approximately 1,800 ac and the total predicted volume of shoal A is approximately 40 MCY. The sand grain size (0.46 millimeter [mm]) is the largest of the 3 sources.

Unnamed shoal B is located offshore approximately 12 mi east of the southern portion of Assateague Island. This shoal covers an area of approximately 3,900 ac. The total predicted sand volume of this shoal is approximately 70 MCY. The average sand grain size is 0.34 mm with a 19 mi transit distance from the shoal to the pump out location.

ACTION AREA

The Action Area is defined at (50 CFR 402.02) as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action." The Service has determined that the Action Area (Figure 4) is the same as that established in the Service's 2016 Opinion. However, for the purpose of discussion of the actions resulting in reinitiation, a subset of the Action Area has been identified as the area impacted by effects of these actions. This area extends from Gargathy Inlet northward to Beach Road on Assateague Island (Figure 5).

Figure 4. Action Area for proposed and ongoing activities.

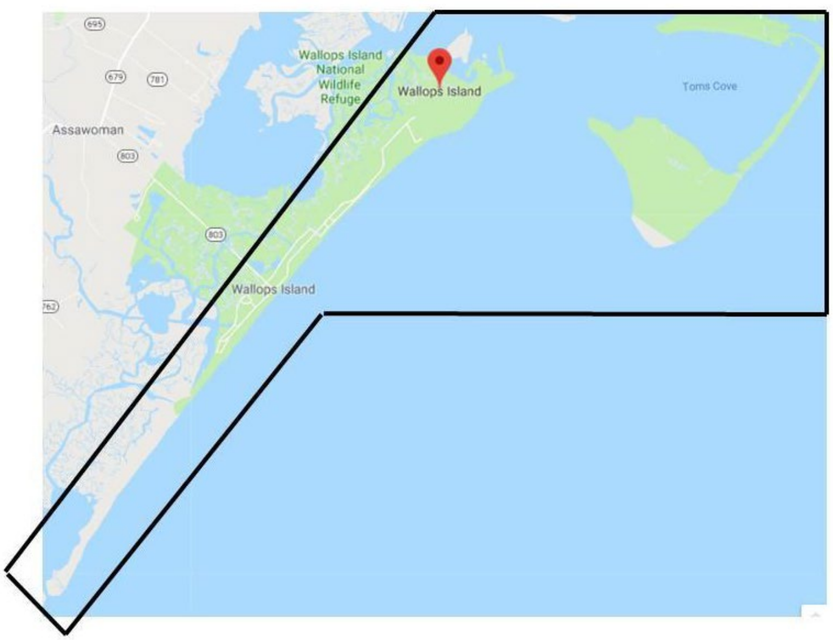

Figure 5. Subset of Action Area—Gargathy Inlet extending northward to Beach Road on Assateague Island.

STATUS OF THE SPECIES

Per ESA section 7 regulations (50 CFR 402.14(g)(2)), it is the Service's responsibility to "evaluate the current status of the listed species or critical habitat."

To assess the current status of the species, it is helpful to understand the species' conservation needs which are generally described in terms of reproduction, numbers, and distribution (RND). The Service frequently characterizes RND for a given species via the conservation principles of resiliency (ability of species/populations to withstand stochastic events which is measured in metrics such as numbers, growth rates), redundancy (ability of a species to withstand catastrophic events which is measured in metrics such as number of populations and their distribution), and representation (variation/ability of a species to adapt to changing conditions which may include behavioral, morphological, genetics, or other variation) (collectively known as the three Rs).

Plover – The Service listed the Atlantic Coast and Northern Great Plains populations of piping plover as threatened on December 11, 1985 (50 FR 50726-50734). The following is a summary of piping plover general life history drawn from the species revised recovery plan (Service 1996) and 5-year review (Service 2009a). For a more detailed account of the species description, life history, population dynamics, threats, and conservation needs, refer to https://ecos.fws.gov/ecp/species/6039.

Plover prey on infaunal invertebrate species such as crabs and worms, which inhabit the surface layer of sand. After they establish territories and conduct courtship rituals beginning in late March or early April, plover pairs form shallow depressions (nests) in the sand to lay eggs. Nests are situated above the high tide line on coastal beaches, sandflats at the ends of sand spits and barrier islands, gently sloping foredunes, blowout areas behind primary dunes, and washover areas cut into or between dunes and typically lay four eggs that hatch in about 27-30 days (Service 1996). The Atlantic Coast piping plover population breeds on coastal beaches from Newfoundland to North Carolina (and occasionally in South Carolina). Plovers then migrate to wintering beaches along the Atlantic Coast from North Carolina south, along the Gulf Coast, and in the Caribbean.

Sea level rise and more frequent, intense storms associated with climate change both pose threats to plovers. Sea level rise combined with coastal development and stabilization presents a considerable threat because the coastal ecosystem's natural ability to respond to sea level rise and generate newly available habitat will be lost. An increase in storm frequency and intensity will exacerbate coastal flooding that will already be increasing due to sea level rise. While climate change related effects on plovers remain a continuing concern (Service 2009a), effects of accelerating sea level rise on future availability of Atlantic Coast piping plover breeding habitats will largely depend on the response of barrier islands and barrier beaches.

The Atlantic Coast piping plover population is distributed among 4 recovery units (RUs) identified as: Atlantic Canada, New England, New York-New Jersey, and Southern (DE-MD-VA-NC) (Service 1996).

To meet the goal of recovery of the Atlantic Coast plover population, the following are recommended (Service 1996):

1. Increase and maintain for five years a total of 2,000 breeding pairs, distributed among four recovery units: Atlantic Canada, 400 pairs; New England, 625 pairs; New York-New Jersey, 575 pairs; Southern (DE-MD-VA-NC), 400 pairs.
2. Verify the adequacy of a 2,000-pair population of piping plovers to maintain heterozygosity and allelic diversity over the long term.
3. Achieve five-year average productivity of 1.5 fledged chicks per pair in each of the four recovery units, based on data from sites that collectively support at least 90% of the recovery unit's population.
4. Institute long-term agreements to assure protection and management sufficient to maintain population targets and average productivity in each recovery unit.
5. Ensure long-term maintenance of wintering habitat, sufficient in quantity, quality, and distribution to maintain survival rates for a 2,000-pair population.

The primary actions to address these criteria include (Service 2009a):

1. Increase efforts to restore and maintain natural coastal formation processes in the New York-New Jersey recovery unit.
2. Identify and secure reliable funding to support continuing management of threats from human disturbance and predation.
3. Accelerate development of agreements needed to assure long-term protection and management to maintain population targets and productivity.
4. Develop strategies to reduce threats from accelerating sea-level rise. Identify sites most likely to maintain (or increase) characteristics of suitable piping plover breeding and/or migration habitat. Identify human coastal stabilization practices that increase or decrease adverse effects of sea level rise on coastal piping plover habitats.
5. Conduct studies to understand potential effects of wind turbine generators that may be located or proposed for the Outer Continental Shelf, nearshore, and within or between nesting and foraging habitats.
6. Conduct studies, including meta-analyses of local studies, to understand factors that affect latitudinal variation in productivity needed to maintain stationary populations of Atlantic Coast piping plovers.
7. Conduct demographic modeling to explore effects of latitudinal variation in productivity, survival rates, and the carrying capacity of habitat on population viability within individual recovery units and the Atlantic Coast population as a whole.
8. Review state laws within the Atlantic Coast piping plover's breeding and wintering range to assess protections that would be afforded if the species were removed from ESA listing.

9. Support effective integrated predator management through studies of ecology and foraging behavior of key predators.

The primary factors influencing the status include habitat loss and degradation, predation, human disturbance, and inadequacy of regulatory mechanisms. Climate change and wind turbine generators have also emerged as threats since publication of the 1996 recovery plan. While 3 of the 4 recovery units have experienced net declines compared with the 2008 estimates that informed the 2009 5-Year review, reinforcing long-standing concerns about the uneven distribution of Atlantic Coast piping plovers, their rangewide status has improved since the 1986 listing (Service 2019a).

<u>Knot</u> – The Service listed the red knot as threatened on January 12, 2015 (79 FR 73705-74748). The following is a summary of red knot general life history drawn from the background information and threats assessment (Service 2014a) and the recovery outline (Service 2019b). For a more detailed account of the species description, life history, population dynamics, threats, and conservation needs, refer to https://ecos.fws.gov/ecp/species/1864.

The rufa red knot migrates annually between its breeding grounds in the Canadian Arctic and several wintering regions, including the Southeast U.S., the Northeast Gulf of Mexico, northern Brazil, and Tierra del Fuego at the southern tip of South America. During both the northbound (spring) and southbound (fall) migrations, red knots use key staging and stopover areas to rest and feed and are highly dependent on the continued existence of quality habitat at these staging areas. Major spring stopover areas along the U.S. Atlantic coast include the Virginia barrier islands and Delaware Bay. In the Southeast U.S., red knots forage along sandy beaches, tidal mudflats, and peat banks during spring and fall migration from Maryland through Florida. The red knot eats hard-shelled mollusks, sometimes supplemented with easily accessed softer invertebrate prey, horseshoe crab (*Limulus polyphemus*) eggs and *Donax spp.* clams (Service 2014a).

Warming temperatures or changes in storm intensity and timing due to climate change may alter when horseshoe crabs lay eggs or invertebrate prey becomes available. This can change peak abundance of prey to occur at a time that does not coincide with arrival of red knots at spring and stopover sites and their Arctic breeding grounds (79 FR 73705-74748). A successful migration is dependent on the timing of these events, so deviations may negatively affect the knot. The availability of alternate prey species for the knot's predators, such as Arctic fox, is being disrupted by climate change. This may increase predation on knots during their breeding season on the Arctic. Additionally, loss of breeding and nonbreeding habitat due to arctic warming and sea level rise, respectively, are increasing extinction risk for the species (79 FR 73705-74748).

To meet the goal of recovery, the following preliminary criteria have been identified (Service 2019b):

1. Populations within all four wintering regions (Argentina/Chile, northern South American coast, northwestern Gulf of Mexico, and southeastern United States/Caribbean) are

sufficiently large and stable, based on adequate surveys and monitoring, and on scientific modeling such as a full-life-cycle population viability analysis;
2. Rates, trends, and trajectories of adult survival, juvenile survival, and reproduction are adequately understood (including consideration of Arctic ecosystem change), and are sufficient to support the resilient wintering populations described in (1) above;
3. The rufa subspecies breeding and nonbreeding distributions are well understood and delineated relative to other subspecies, and the rufa population structure is clarified (e.g., genetic relationships among subspecies, and among the rufa wintering regions);
4. A network of key wintering habitats and major spring and fall migration staging areas across North America and South America provides sufficient suitable food resources at the appropriate times in the annual cycle and is adequately managed and protected;
5. Migration stopover habitats across the range (in addition to the key staging areas) are sufficient to allow red knots to adapt to short-term (e.g., annual weather, food, predation, disturbance conditions) and long-term (e.g., climate change, sea level rise, habitat modification) changes in their migratory landscape and timing, and are adequately managed and protected.

A preliminary action plan identified the following near-term actions (Service 2019b):

1. Support, encourage, and if possible, fund the research priorities listed in U.S. Fish and Wildlife Service Rufa Red Knot Research Priorities, 2019 to 2022.
2. In Delaware Bay, continue the Service's active role in horseshoe crab management, in the management of intertidal aquaculture, and in supporting State-led efforts to monitor and protect red knots, with a goal of steadily increasing the percent of red knots that depart the bay at adequate weights even as numbers of knots using the bay also increases.
3. Avoid and minimize loss and degradation of nonbreeding habitat from coastal engineering and development
    a. Work through the Atlantic Flyway Shorebird Initiative's (AFSI) Coastal Engineering Committee (Habitat Work Group) to develop best practices.
    b. Work with the Corps and the States to adopt the best practices at the landscape- and project-level scales (e.g., through sections 7(a)(1) and 7(a)(2) of the ESA).
    c. Focus on documented red knot staging areas, as well as regularly used stopover and wintering habitats. When possible, pursue multispecies conservation opportunities that also benefit other State or federally listed species.
4. Work with partners to preserve, enhance, and restore nonbreeding habitat, both proactively and incidental to engineering and development projects. For example, carefully planned beach nourishment can increase of improve red knot habitat in some areas, such as parts of Delaware Bay.
5. Develop Service recommendations for managing recreation and other sources of human disturbance in red knot nonbreeding habitats. In developing the recommendations, build on related work being done by the National Wildlife Refuge System, through the AFSI's Human Activities Committee (Habitat Working Group), and in the piping plover wintering range. Work with land managers and project proponents to implement the

Service's recommendations. Also work with recreation user groups (e.g., fishermen) to enlist support for minimizing disturbance of red knots.

6. Work with partners to monitor and manage invasive vegetation in red knot nonbreeding habitats.
7. Work with land managers to evaluate gull and raptor management in the vicinity of red knot nonbreeding habitats on a case-by-case basis. In some instances, management adjustments may be warranted, such as relocating peregrine falcon (*Falco peregrinus*) nesting structures. Build on the AFSI's forthcoming shorebird predation best management practices.
8. Work with the U.S. Coast Guard and other partners to identify key red knot habitats in oil spill response planning, and prioritize these areas for protection in the event of a spill.
9. Work with wind energy developers and regulators to explore alternatives to siting new wind turbines in red knot concentration areas of along major migration pathways.
10. Work with all States, Service Regions, and the U.S. Geological Survey's Bird Banding Lab to ensure best practices are followed by all individuals and entities engaged in red knot trapping, marking, and other research.
11. Establish a Red Knot Information Partnership of interested species experts, researchers, and conservation practitioners from across the species' range. Facilitate the exchange of information by establishing an email listserve and perhaps other electronic tools/platforms. Hold and annual conference call or webinar to discuss collaborative research, new advances in red knot science, new information about threats, and new developments in conservation. Hold ad hoc conference calls of webinars to address less urgent issues as they arise.
12. Enhance and facilitate international cooperation on red knot research and conservation.

The primary threats to the knot are: habitat loss and degradation attributable to sea level rise, shoreline stabilization, and Arctic warming; and reduced food availability and asynchronies in the migration timing relative to food availability and favorable weather conditions. Secondary threats include hunting, predation, human disturbance, algal blooms, oil spills and wind energy development.

Sufficient reliable data to produce a rangewide population estimate is not available. However, the best available data indicate a sustained decline in the early 2000s and the possibility of stabilization at low levels in recent years. In summary, as a whole, the rangewide status of the species is stable (Service 2019b).

Loggerhead – The Service and National Marine Fisheries Service (NMFS) jointly listed the loggerhead sea turtle as threatened on July 28, 1978. The following is a summary of loggerhead sea turtle general life history drawn from the species' recovery plan (NMFS and Service 2008), 5-year review (NMFS and Service 2007), and 2009 status review (Conant et al. 2009). For a more detailed account of the species description, life history, population dynamics, threats, and conservation needs, refer to https://ecos.fws.gov/ecp/species/1110.

Loggerhead sea turtles inhabit temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans. Adult loggerheads are known to make long migrations between foraging areas and nesting beaches. The highly migratory behavior of loggerheads means that conservation efforts for loggerhead populations in one country may be jeopardized by activities in another (NMFS and Service 2008). Loggerheads nest on ocean beaches and occasionally on estuarine shorelines with suitable sand, typically between the high tide line and the dune front. Within the continental U.S., loggerheads nest from Texas to Virginia. Nesting is often highly variable from year to year due to a number of factors including environmental variability, ocean conditions, anthropogenic effects, and factors affecting survival, growth, and reproduction (NMFS and Service 2008). Hatchlings emerge from their nests en masse almost exclusively at night, and presumably use decreasing sand temperature as a cue. Hatchlings then use light cues to find the ocean; ambient light from the open sky creates a relatively bright horizon compared to the dark silhouette of the dune and vegetation landward of the nest (NMFS and Service 2008).

Climate change may impact loggerheads through sea level rise and rapidly increasing temperatures. Sea level rise may contribute to the loss of nesting habitat through inundation of nest sites and beach erosion, which will be compounded by increasing coastal development and stabilization. Given that sea turtles exhibit temperature-dependent sex determination, global increases in temperature may also increase sand temperatures and increases incubation temperatures resulting in female-biased sex ratios (NMFS and Service 2008).

Five RUs have been identified in the Northwest Atlantic Ocean DPS based on genetic differences and a combination of geographic distribution of nesting densities, geographic separation, and geopolitical boundaries. The first 4 RUs represent nesting assemblages in the southeast U.S. The boundaries of these 4 RUs were delineated based on geographic isolation and geopolitical boundaries. The fifth RU includes all other nesting assemblages within the Northwest Atlantic. While the Northern RU includes southern Virginia, the Eastern Shore is not part of any RU.

To meet the recovery goal of the loggerhead, the NMFS and Service (2008) recommended the following recovery criteria:

1. Number of Nests and Number of Nesting Females
    a. Specific nest numbers and rate of increase varies by recovery unit, but increase in number of nests must be a result of corresponding increases in number of nesting females (estimated from nests, clutch frequency, and remigration interval).
2. Trends in Abundance on Foraging Grounds
    a. A network of in-water sites, both oceanic and neritic across the foraging range is established and monitoring is implemented to measure abundance. There is statistical confidence (95 percent) that a composite estimate of relative abundance from these sites is increasing for at least one generation.
3. Trends in Neritic Strandings Relative to In-water Abundance
    a. Stranding trends are not increasing at a rate greater than the trends in in-water relative abundance for similar age classes for at least one generation.

To address these criteria for the Northwest Atlantic DPS the recovery plan (NMFS and Service 2008) lists the 208 primary actions, of which there are 34 Priority 1 actions.

The primary factors influencing the status include bottom trawl, pelagic and demersal longline, longline, and demersal large mesh gillnet fisheries; legal and illegal harvest; vessel strikes; beach armoring; beach erosion; marine debris ingestion; oil pollution; light pollution; and predation by native and exotic species. Numerous beaches in the Southeast U.S. are eroding due to both natural (e.g., storms, waves, shoreline geology) and anthropogenic (e.g., construction of armoring structures, groins, and jetties; coastal development; inlet dredging) factors. Such shoreline erosion leads to a loss of nesting habitat for sea turtles (Conant et al. 2009). In summary, as a whole, the rangewide status of the species is declining (NMFS and Service 2008).

STATUS OF CRITICAL HABITAT

Plover – Critical habitat for the wintering population of plover has been designated along the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas; however, this action does not affect those areas.

Knot – No critical habitat has been designated for knot.

Loggerhead – Critical habitat for the loggerhead Northwest Atlantic Ocean DPS has been designated along approximately 685 mi of specific terrestrial environments along the U.S. Atlantic and Gulf of Mexico coasts; however, this action does not affect those areas.

ENVIRONMENTAL BASELINE

Regulations implementing the ESA (50 CFR 402.02) define the environmental baseline as the past and present impacts of all federal, state, or private actions and other human activities in the Action Area. Also included in the environmental baseline are the anticipated and/or ongoing impacts of all proposed federal projects in the Action Area that have undergone Section 7 consultation, and the impacts of state and private actions which are contemporaneous with the consultation in progress.

Status of the Species within the Action Area

Plover – The Action Area is within the Southern RU. Following low productivity in 2016 and 2017, the number of breeding pairs in Virginia and the Southern RU (for which Virginia is the largest contributor) declined sharply in 2018. While 2018 productivity estimates appear to have increased slightly from 2017, it was not sufficient to stabilize the breeding population (Service 2017; A. Hecht, Service, email to E. Argo, Service, October 30, 2018).
Within the Action Area, plovers use wide sandy beaches on Metompkin, Assawoman, Wallops, and Assateague Islands for courtship and nesting (Table 2 and 3). Suitable habitat has a variable distribution along the seaward edge of islands within the Action Area year-to-year due to the

competing effects of erosion and vegetation succession. Annual plover production within the Action Area indicates that all islands possess some nesting habitat, with the most extensive areas of suitable beach occurring on Assawoman Island and in the Hook, Overwash, and Public Beach portions of Assateague Island (Service 2009b). Metompkin Island also supports large numbers of plovers (Smith et al. 2009). Little potential habitat is available for plover nesting on the south end of Wallops Island, although 1-2 birds originating from nesting areas south of Wallops Island are known to forage near camera stand Z-100 (S. Miller, NASA, email to E. Argo, Service, May 8, 2019; S. Miller, NASA, email to E. Argo, Service, June 6, 2019; see Figure 9). The north end of Wallops Island has been rapidly accreting, offering increasing quantities of wide sandy beach on which plovers nest. Shoreline restoration created a substantial increase in beach habitat available on Wallops Island north of the reconstructed seawall and south of the north Wallops Island area (NASA 2015a).

Most plovers that nest farther north within the Atlantic population are likely to pass through the Action Area during migration between mid-February and mid-May in the spring and from mid-July to mid-October in the fall. This may involve birds passing through in flight, but many of these birds may stop and roost or feed on beaches, tidal flats, and overwash areas within the Action Area. While breeding plovers select a narrower range of micro-habitats in Virginia compared to other areas along the East Coast of the U.S. and outside of the Southern RU and changes in habitat suitability may be a factor in the recent decline, it seems unlikely that the habitat was completely saturated in 2018 (A. Hecht, Service, email to E. Argo, Service, October 30, 2018).

Table 2. Plover nest and fledgling numbers for islands in Action Area (Service 2009b, 2014b, 2018a, 2018b; Smith et al. 2009; NASA 2010b, 2011, 2012b, 2013, 2014a, 2015b, 2016, 2017, 2018)

Year	Island	Number of Nests	Number of Chicks Fledged
2009	Assateague (Hook, Overwash, and Public Beach)	32	26
	Wallops	4	10
	Assawoman	26	31
	Metompkin	46	51
2010	Assateague (Hook and Overwash)	32	54
	Wallops (first season of official monitoring program)	4	4
	Assawoman	24	35
	North Metompkin	3	4
2011	Assateague (Hook and Overwash)	27	41
	Wallops	3	9
	Assawoman	32	52
	North Metompkin	8	11
2012	Assateague (Hook and Overwash)	20	9
	Wallops	6	3
	Assawoman	39	78
	North Metompkin	11	15
2013	Assateague (Hook and Overwash)	31	29
	Wallops	3	8
	Assawoman	40	60
	North Metompkin	14	15
2014	Assateague (Hook and Overwash)	42	70
	Wallops	5	5
	Assawoman	40	71
	Metompkin	53	82
2015	Assateague (Hook and Overwash)	47	59
	Wallops	6	8

Year	Island	Number of Nests	Number of Chicks Fledged
	Assawoman	33	28
	Metompkin	61	78
2016	Assateague (Hook and Overwash)	61	36
	Wallops	9	9
	Assawoman	30	39
	North Metompkin	11	15
2017	Assateague (Hook and Overwash)	52	43
	Wallops	6	7
	Assawoman	38	14
	North Metompkin	12	5
2018	Assateague (Hook and Overwash)	34	--
	Wallops	3	3
	Assawoman	23	--
	North Metompkin	10	--

Table 3. Plover nest data for Wallops Island.

Year	Earliest Nest Date	Latest Fledge Date	Number of Nests
2010	May 3	n/a	3
2011	May 16	June 19	3
2012	May 24	Aug 16	5
2013	May 15	July 22	4
2014	May 20	July 20	5
2015	May 13	July 9	6
2016	May 31	July 5	9
2017	May 1	Aug 10	6
2018	May 21	July 13	3

Knot – Following migration from southern overwintering areas, the majority of knots arrive in the mid-Atlantic between late April and early June. The Delaware Bay has long been regarded as the final and most crucial stopover during the springtime northern migration. At this stopover, the birds gorge on eggs of spawning horseshoe crabs in preparation for their nonstop flight to the Arctic (Karpanty et al. 2006). Virginia's Eastern Shore also provides important stopover habitat, including Wallops Island (Watts and Truitt 2015).

The majority of knot activity on Wallops Island occurs on the north end of the island, well north of launch Complex 0 during the month of May (NASA 2012b, 2013, 2014a, 2015b, 2016, 2017, 2018). Flock sizes have varied year-to-year, with the smallest numbers observed in 2014 (Table 4 and Figure 6). Although the potential exists for knot foraging activity to occur within the renourished beach area adjacent to the launch pads, their presence on the regularly nourished beach is unlikely due to the suppressed forage base and resultant lower habitat value.
Knots have also been observed on Assawoman and Assateague Islands from May through September. Flock sizes have ranged from a single birds to over 100 individuals since 2014 (Service 2018c).

Along Virginia's Eastern Shore, knots make use of beach and peat bank habitats (Service 2015a). They have been documented feeding both day and night, which may be necessary to meet energy requirements from available prey species to complete migration (Cohen et al. 2011). During the 2006 and 2007 migration seasons, Virginia supported a knot population of over 7,000 individuals (Cohen et al. 2009). Counts during peak migration have documented both increases and decreases from 2007 through 2018 (Karpanty et al. 2018). Additionally, wintering knots are known to occur on Virginia's Eastern Shore (S. Karpanty and J. Fraser, Virginia Polytechnic Institute and State University, per. obs. March 13, 2019), but the Service is not aware of data identifying the Action Area as part of these wintering grounds.

Table 4. Knot migration data for Wallops Island (NASA 2010b, 2011, 2012b, 2013, 2014a, 2015b, 2016, 2017, 2018).

Year	Annual Maximum Number Observed	Annual Mean of Numbers Observed
2010	483	180
2011	407	100
2012	672	293
2013	1162	383
2014	34	9
2015	560	218
2016	383	179
2017	150	83
2018	223	98

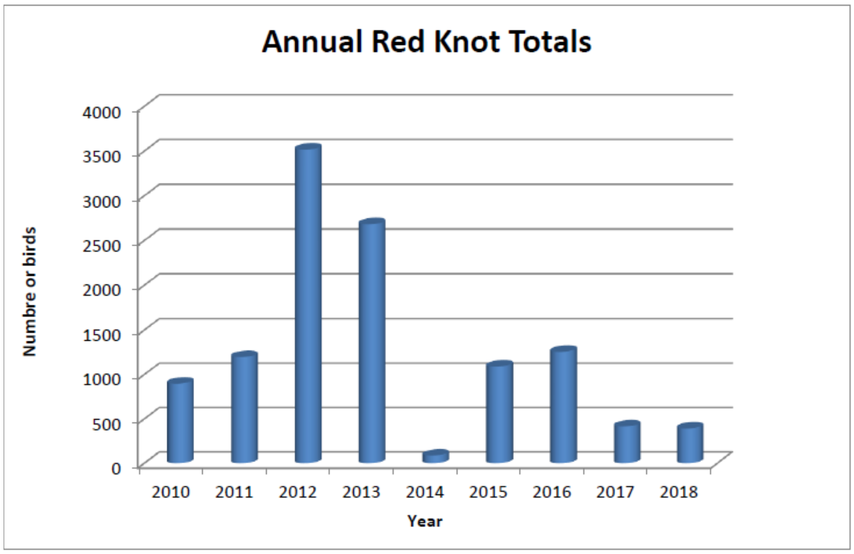

Figure 6. Total of numbers of knots observed on the north end of Wallops Island (NASA 2018).

Loggerhead – The loggerhead occurs in waters adjacent to and offshore of islands within the Action Area. The Action Area is at the northern extent of recorded nesting activity for the species. Loggerheads are known to occasionally nest within the Action Area, primarily on Assateague Island (Table 5 and 6). In Virginia, nesting has been documented from May through August (Virginia Department of Game and Inland Fisheries [VDGIF] 2017), with hatching occurring approximately 60 days later.

Nests on Wallops Island have been documented on the recreational beach and in front of the rock wall, but are not documented every year (Table 6 and Figure 7; NASA 2010b, 2011, 2012b, 2013, 2014a, 2015b, 2016, 2017, 2018). Results of DNA analysis indicated that nests in 2010 were all dug by a single female (NASA 2010b). There is no evidence of sea turtle nesting documented on Wallops Island since 2014 (NASA 2014a, 2015b, 2016, 2017, 2018). As more southern beaches warm and nests experience increased egg mortality, nesting activity may shift in a northerly direction. In addition, some southern nesting beaches have been producing highly female-skewed sex ratios for decades (e.g., Hanson et al. 1998), so northern beaches that produce more males may become more important to the species recovery.

Table 5. Loggerhead nest activity within the Action Area from 1974-2017 (Service 2009c, 2015b, 2018d; VDGIF 2017; NASA 2010b, 2011, 2012b, 2013, 2014a, 2015b, 2016, 2017, 2018).

Location	False Crawls	Nests	Total Activity
Metompkin Island	0	0	0
Assawoman Island	1	0	1
Wallops Island	22	13	21
Assateague Island – Hook and Overwash	72	38	141

Table 6. Loggerhead crawl and nest dates and numbers for Wallops Island (NASA 2010b, 2012b, 2013, 2014a).

Year	Latest Crawl Date	Latest Expected Hatch Date	Number of Crawls/Nests
1975	July 24	October 22	3/0
1979	July 21	October 19	1/1
1982	July 14	October 12	1/1
1989	June 5	September 3	1/1
2002	July 9	October 7	1/1
2008	August 3	November 1	2/1
2010	July 28	October 26	6/4
2012	July 12	October 10	4/2
2013	July 26	October 24	3/2

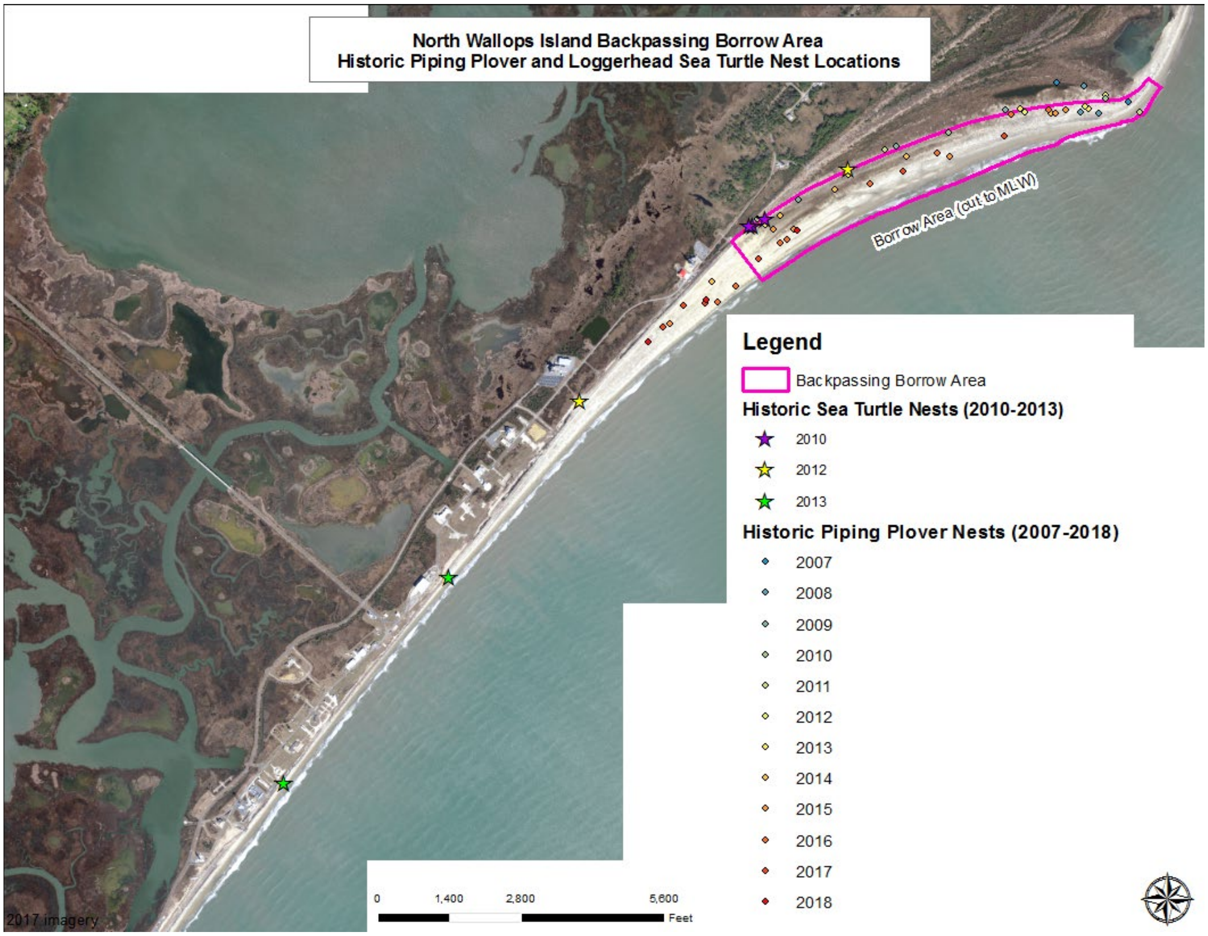

Figure 7. Historic plover and loggerhead nest locations. Image provided by NASA.

EFFECTS OF THE ACTION

Direct effects are the direct or immediate effects of the project on the species, its habitat, or designated/proposed critical habitat. Indirect effects are defined as those that are caused by the proposed action and are later in time, but still are reasonably certain to occur (50 CFR 402.02). An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation. Direct and indirect effects of the proposed action along with the effects of interrelated/interdependent activities are all considered together as the "effects of the action." For the purposes of this Opinion, we are considering the effects of the action over the next 15 years.

The Corps' Chincoteague Inlet Inner Channel Federal Navigation Project was originally approved in 1972 (*https://www.nao.usace.army.mil/About/Projects/ChincoteagueNav.aspx*; accessed May 17, 2019) and has been taking place an average of twice a year (Corps 2019) in the waters adjacent to Wallops Island, within the Action Area (Figure 8). The Corps' permit expired on April 29, 2019 and the Corps submitted a Joint Permit Application on February 25, 2019 to continue the project (Corps 2019). In the model provided by NASA and conducted by the Corps, it was stated that the proposed beach nourishment activities should have no effect on the channel given that it has not needed to be dredged in 7 years, any dredging conducted will only be for maintenance, and sand material is not accumulating in the channel (Corps 2018a). While the Corps recognized it would be ideal to include the inlet in the numerical model, they elected not to include this information due to the need for a full sediment budget. As a result, NASA did not provide the Service with any information regarding potential effects to listed species from the interaction of the Navigation Project, backpassing, and beach nourishment. The Corps has not consulted with the Service on the Navigation Project nor do we have any sources of information available from which to assess effects on listed species.

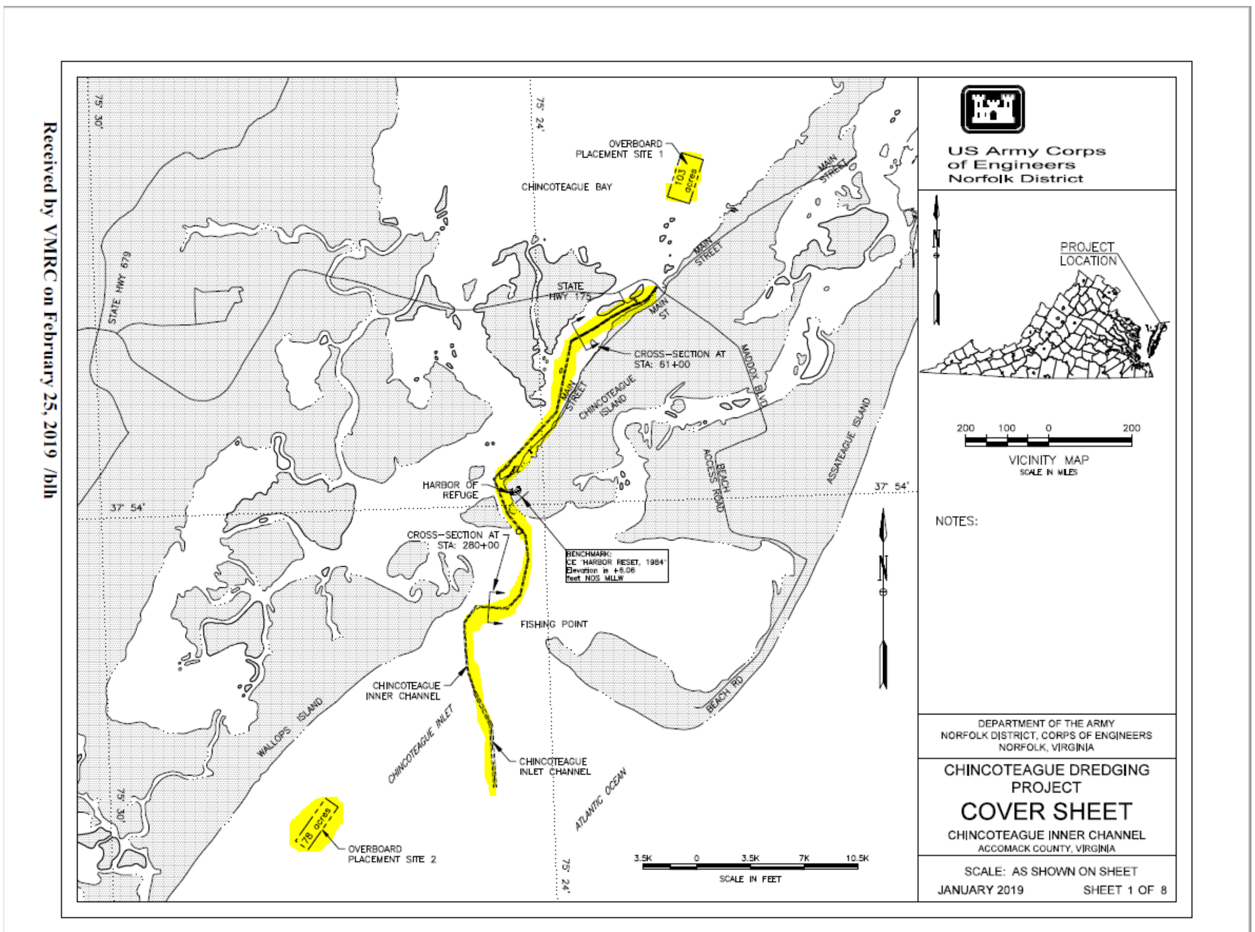

Figure 8. Dredging and sand placement sites highlighted in yellow (base image from Joint Permit Application).

The potential effects of the proposed activities are described in Table 7 (see Appendix A) and 8. Activities in Table 7 require reinitiation, while those in Table 8 remain unchanged from the Service's 2016 Opinion.

Those components of the proposed action requiring reinitiation determined to result in "no effect" or "not likely to adversely affect" are described in Table 7 and will not be further discussed in this Opinion. Multiple components of the project have been identified as having the potential to affect plovers, knots, and loggerheads (Table 7). These include:

- Operation of equipment (day)
- Operation of equipment (night)
- Presence of additional personnel
- Sand excavation
- Renourishment
- Breakwater construction
- Equipment staging
- Sand stockpile

Effects to federally listed species from the actions necessitating reinitiation were evaluated based on data in the shoreline change and transport model (GenCade) (Corps 2018a, 2018b) provided to the Service by NASA. Experts in the fields of coastal geomorphology and sediment transport have indicated that there will be impacts to Assateague and Assawoman Islands beyond the immediate Wallops Island area; however, the magnitude and extent of these impacts is unknown at this time (Varnell 2019). Information on the sediment transport dynamics in the area surrounding Wallops Island is incomplete, but the information necessary to develop additional models is not currently available (L. Varnell, Virginia Institute of Marine Science, pers. obs. November 26, 2018).

Given that backpassing, and the associated renourishment and equipment use, is anticipated to take place on a 10-year interval, the effects described below and in Table 7 are anticipated to occur following a second round of backpassing and renourishment in 2029-2030. Similarly, renourishment activities, using an offshore shoal as a sand source, are expected to continue on a 2-7 year interval and the effects described below and in Table 7 are anticipated to occur following each subsequent renourishment event. Because NASA is unable to more specifically predict the frequency of renourishment activities using the offshore shoal as a sand source, we are assuming that renourishment will occur every 2 years during the 15 year timeframe of this Opinion (2021, 2023, 2025, 2027, 2031, 2033) except during the years where backpassing and associated renourishment occurs.

Backpassing (sand excavation) and renourishment

Plover – Sand excavation will remove nesting habitat at the northern end of Wallops Island, resulting in a reduction in breeding carrying capacity, lack of nesting, and birds searching for suitable nesting habitat elsewhere. Searching for alternative suitable habitat leads to increased energy expenditure from additional search times and increases exposure to predators. Expending additional energy searching for and reaching suboptimal habitat that may have limited food resources does not allow plovers to maintain optimal body condition, resulting in decreased nest productivity or inability to nest. The use of suboptimal habitat may lead to nesting on less suitable habitat, such as on a narrower beach more vulnerable to flooding, and decreased nest or brood attendance by adults could increase predation of eggs and/or chicks. If the habitat is suboptimal, foraging opportunities may be limited and decrease chick survival. If birds seek nesting habitats elsewhere, they will also face competition for territories with birds already established there, leading to lower productivity and lower adult survival from reduced food availability. Optimal nesting habitat will be unavailable in the sand excavation area until sand accretes to the northern end of Wallops Island 4-6 years post-excavation (Corps 2018a, 2018b).

Renourishment (placement of backpassed sand) will reduce the quality of nesting habitat. Birds that have been nesting in the area proposed for renourishment may continue to return and attempt to nest, resulting in lower nest productivity (A. Hecht, Service, pers. obs. April 24, 2019). This will cause a loss in carrying capacity in the Action Area and the loss and degradation of this nesting area may cause long-term adverse impacts to population productivity and growth. Birds may seek nesting habitat elsewhere, resulting in the effects described above. Additionally, as compared to nesting plovers on beaches in the northeastern U.S, nesting plovers may abandon their nests since birds along the Eastern Shore of Virginia startle or flush easily (R. Boettcher, VGDIF, pers. obs. March 29, 2019).

Renourishment will also bury available prey. Recovery of invertebrate prey species varies based on time of year of renourishment and technique used (Corps 1982, Schlacher et al. 2012, Bishop et al. 2006). Over time, the characteristics of a natural beach are expected to return as the renourished area is recolonized by native fauna and plants, and as wave action, wind, rain, and other natural forces weather the beach (National Research Council 1995). Plovers will expend additional energy seeking available foraging habitat elsewhere, resulting in the effects described above. We expect that beach habitat will be unsuitable for plover foraging for 1 year following renourishment.

<u>Plover and knot</u> – Sand excavation will impair or kill invertebrate prey species and will remove or alter habitat making the site unavailable or less desirable for foraging for plovers and knots. Sand will be excavated to MLW, creating tidal pools. *Donax* spp., a primary knot food source, will likely be suppressed when material is systematically removed from the intertidal zone, as proposed. Additionally, wrack, another source of forage for knots and plovers, will be displaced. However, wrack is expected to more rapidly regenerate as compared to *Donax*. As a result, foraging habitat on the northern end of Wallops Island will be unavailable until sand accretes to the backpass area in 4-6 years (Corps 2018a, 2018b) and prey species recover. Knots and plovers are expected to search for alternative suitable habitat leading to increased energy expenditure from additional search times and increased exposure to predators. Suboptimal habitat may have more predators, thus increasing predation risk, resulting in harm or death. For knots, if the nearby islands that provide alternate habitat do not provide sufficient resources to fulfill their foraging needs, there is a risk that they will not reach an adequate weight, which will negatively affect their breeding success in the Arctic.

Loggerhead – Loggerheads have nested in both the areas slated for sand excavation and renourishment. The removal of sand will remove known nesting habitat, resulting in a lack of nesting or expenditure of additional energy to find a suitable nesting site. Beach habitat in the sand excavation area will be unavailable for sea turtles for at least 2 consecutive nesting seasons following sand mining. Return of previous beach topography that provided nesting habitat is expected to take 4-6 years.

Placement of sand may alter beach topography and result in sand compaction, reducing the quality of nesting habitat. If a female does attempt to nest, the sand may have been compacted by equipment, reducing the female's ability to dig a nest chamber. However, a portion of the area where nests have been documented (in front of the riprap protection) has eroded in recent years and the addition of sand to this area could increase available nesting habitat along this stretch of Wallops Island. On most beaches, nesting success typically declines for the first 1 to 2 years following sand placement, even though more nesting habitat is available for turtles (Conant et al. 2009). However, the effects of beach renourishment on nesting are not predictable and potential effects should be considered on a case-by-case basis (Crain et al. 1995). NASA has observed nesting on renourished areas on Wallops Island in both 2012 and 2013 (NASA 2012b, 2013). Nest failure and reduced rates of hatchling emergence are expected to occur for up to 2 years after sand placement.

Operation of heavy equipment (day and night) and presence of additional personnel

Plover – Operation of equipment and presence of additional personnel will discourage habitat use and cause plovers to expend additional energy seeking available habitat elsewhere. Searching for alternative suitable habitat leads to increased energy expenditure from additional search times and increases exposure to predators. Expending additional energy searching for and reaching suboptimal habitat that may have limited food resources does not allow plovers to maintain optimal body condition, resulting in decreased nest productivity or inability to nest. This may lead to nesting on less suitable habitat, such as on a narrower beach more vulnerable to flooding, and decreased nest or brood attendance by adults could increase predation of nests and/or chicks. If the habitat is less suitable foraging opportunities may be limited and decrease chick survival. If birds seek nesting habitats elsewhere, they will also face competition for territories with birds already established there, leading to lower productivity and possibly adult survival from reduced food availability. Additionally, nesting plovers may abandon their nests since birds along the Eastern Shore of Virginia flush easily (R. Boettcher, VDGIF, pers. obs. March 29, 2019).

Plover and knot – Operation of equipment will generate noise, disturbing foraging and roosting individuals. Individuals are likely to cease normal behaviors and alter their flight path, causing them to expend additional energy reaching habitat that may have limited food resources that does not allow them to maintain optimal body condition and cause them to spend a longer time foraging, thereby increasing their vulnerability to predators. The release of small amounts of fuel from the equipment may directly impact plovers and knots through ingestion or by getting on their feathers harming the birds. Fuel releases will also and negatively impact their prey species, reducing prey availability and quality causing the birds to spend additional time foraging, increasing the time they are available to predators. Additionally, sand compaction from equipment will cause burial or suffocation of invertebrate prey species and generally degrade the foraging habitat. The presence of additional personnel will also discourage the use of the habitat for foraging, causing the birds to seek suitable habitat elsewhere. Searching for alternative suitable habitat leads to increased energy expenditure from additional search times and increases exposure to predators. For knots, use of suboptimal foraging habitat may also result in lower weight when reaching the Arctic leading to reduced reproductive success.

Loggerhead – A nesting female may encounter operating equipment on the beach that could deter nesting attempts. If a female does attempt to nest, the sand may have been compacted by equipment, reducing the female's ability to dig a nest chamber, resulting in a reduction in nesting success. If hatchlings travel beyond the 1,000 ft buffer they may be crushed by operating equipment or encounter ruts and divots left by equipment that make it difficult to travel to the ocean and make them more vulnerable to predators while traversing the beach.

Breakwater construction

Plover and knot – Breakwater construction will generate noise, disturbing foraging plovers and knots. Individuals are likely to cease normal behaviors and alter their flight path, causing them to expend additional energy searching for available habitat elsewhere. Searching for alternative suitable habitat leads to increased energy expenditure from additional search times and increases exposure to predators. Suboptimal habitat may have limited food resources that does not allow plovers or knots to maintain optimal body condition and may also have a larger number of predators, thereby increasing their vulnerability to predators. For knots, use of suboptimal foraging habitat may result in lower weight when reaching the Arctic leading to reduced reproductive success.

Breakwaters would also change the beach topography, causing tombolos to form and reducing the rate of recovery of the foraging (plover and knots) and nesting (plovers) habitat. The effects of the reduced rate of habitat recovery on plovers and knots are the same as those discussed above.

Equipment staging

Loggerhead – Equipment staging areas may be modified daily and may not always be established in an upland area. Any equipment staged on the sand/beach may present an obstacle to nesting loggerheads causing them to return to the ocean instead of nesting or expend additional energy to find a suitable nesting site, resulting in a reduction in nesting success. Hatchlings may encounter equipment on the beach at night during hatching if they travel outside of the 1,000 ft buffer, causing them to spend more time reaching the ocean, leaving them vulnerable to predators, which increases the likelihood of harm or death.

Sand stockpile

Loggerhead – Any sand stockpiled on the beach may present an obstacle to nesting loggerheads causing them to return to the ocean instead of nesting or expend additional energy to find a suitable nesting site, resulting in a reduction in nesting success. Hatchlings may encounter the stockpile on the beach at night during hatching if they travel outside of the 1,000 ft buffer or a nest is laid after the stockpile has been established and, therefore, is within the 1,000 ft buffer. This will cause hatchlings to spend more time reaching the ocean, leaving them vulnerable to predators, which increases the likelihood of harm or death.

The effects of the actions remaining unchanged from the Service's 2016 Opinion are detailed below.

Table 8. Expected direct and indirect effects of the proposed actions.

Action	Direct and Indirect Effects					
	Noise	Vibration	Rocket Exhaust	Use Related Disturbance	Lighting	Habitat Loss/Suitability
Liquid Fueled ELV Launches	X	X	X		X	
Solid Fueled ELV Launches	X	X	X		X	
ELV Static Fires	X	X	X		X	
Sounding Rocket Launches	X	X	X		X	
Sounding Rocket Static Fires	X	X	X		X	
Disposal of Defective or Waste Rocket Motors	X		X			
Drone Target Launches	X	X	X		X	
UAS Flights	X	X			X	
Piloted Aircraft Flights	X	X			X	
Restricted Airspace Expansion	X					
Range Surveillance/Facility Security	X			X		
Construction	X				X	
Routine Facility Maintenance	X					
Launch Pad Lighting					X	
Recreational/ ORV Beach Use				X		
Protected Species Management				X		
Miscellaneous Activities on Wallops Island Beach				X		
Education Use of Wallops Island Beach				X		
Seawall Repair				X		
Shoreline Reconstruction Monitoring				X		
Beach Renourishment (from offshore shoal)				X		X

Noise

Effects on plover, knot, and loggerhead from liquid fueled ELV launches, solid fueled ELV launches, ELV static fires, sounding rocket launches, sounding rocket static fire testing, disposal of waste rocket motors, drone target launches

Support activities prior to a rocket launch include transportation of rocket parts between storage facilities and the launch complex and other associated activities. Support activities often result in an increase in noise and general activity due to additional presence of people in the vicinity of the rocket launch areas. Increased noise from support activities may disturb loggerheads attempting to nest and nesting plovers on the sound end of Wallops Island.

Ignition of rocket engines for orbital launches or static tests will produce instantaneous noise audible for a considerable distance from Launch Complex 0. In close proximity to the launch sites, the noise generated will be high intensity across a broad range of frequencies. Sound intensity may exceed 160 decibel (dB) on the beach and dune in close proximity to launch sites. The WFF Range Safety Office, using the NASA rocket size/noise equation (NASA 2009), estimated noise levels expected to occur during launches of envelope vehicles from each launch pad in the complex. An LMLV-3(8) rocket launched from pad 0-B will produce a noise level of 129 dB at 0.68 mi, attenuating to 108 dB up to 7.8 mi from pad 0-B. As many as 12 such launches could be performed per year at pad 0-B. Noise levels from static tests performed at pad 0-A will reach 124 dB within a 1 mi radius, attenuating to 108 dB at a distance of 6 mi from pad 0-A. As many as 6 launches and 2 static tests could be performed per year at pad 0-A. These noise levels are expected to be sustained for 30 to 60 seconds during a launch and for up to 52 seconds during a static test. Plover and loggerhead nests may occur within 328 ft of the launch sites, and when they occur between 328 ft and 1 mi of launches, they will be subjected to high intensity sound. The majority of knot activity on Wallops Island occurs on the north end of the island, more than 1.8 mi north of Pad 0-A (NASA 2012b, 2013, 2014a). Knot presence on the regularly nourished beach is unlikely due to the suppressed forage base. It is unlikely that knot will be subjected to high intensity sound on north Wallops Island.

Deafening of plovers, knots, and loggerheads is not expected at the decibel levels predicted at 0.7 to 0.9 mi from launches, but progressively closer to the rockets, the noise intensity may reach levels that could cause tissue damage. While not known in birds specifically, sound intensity of near 180 dB can result in nearly instantaneous tissue damage to the inner ear (McKinley Health Center 2007). Exposure to noises within these radii could deafen plovers or knots present during ignition if exposed to high intensity noise. Deafness will significantly impair the ability of a plover or knot to breed, shelter, and behave normally. In addition to deafening, low frequency and high intensity sound expected in very close proximity to the launch sites may be debilitating and cause disorientation or loss of balance, but these effects are not well established (Leventhall et al. 2003). Birds may be able to recover from sound-induced deafening over time (Adler et al. 1995), but some period of deafness may result from loud noises. Birds may recover from disorientation and other sound-induced effects, but the amount of time required is not known for plover or knot. Debilitated birds will be subject to increased vulnerability to predators and physiological stress, resulting from inability to detect and avoid predators, feed, care for eggs/young, and seek shelter.

Burger (1981) demonstrated startle effects in birds exposed to anthropogenic sound pressure of 108 dB. Within 6 mi of pad 0-A, such noise levels will occur as a result of rocket launches or static tests as many as 20 times per year. Several other sources of loud noises exist in the Action Area. Anthropogenic sources include: sounding rocket and drone target launches from Wallops Island, waste engine disposal at the open burn area on Wallops Island, and aircraft landing and taking off from Wallops Main Base and the UAS runway on Wallops Island. Collectively, several thousand such events take place within WFF annually (NASA 2005, 2015a). Some of these activities produce noise levels similar to the noise expected to be produced by the large rocket launches. While many of these sounds are of similar intensity, the frequency of the sounds varies, with noise generated from rocket launches generally in the low frequency range and aircraft noise generally in higher frequency ranges.

Plovers and knots not debilitated by high intensity noise are expected to be disturbed by launches and exhibit a startle response that interferes with normal behaviors, including breeding, feeding, and sheltering. It is not likely that plovers and knots will startle or flush from all of the relatively intense sound disturbances. Individual birds may become habituated to the noises. Some of the noises are likely below the disturbance threshold, will be attenuated by atmospheric conditions, or may occur during periods of elevated natural noise intensity (e.g., strong winds, large waves) so that the noises will be less intense relative to background noise levels.

In response to high intensity noises, plovers are not expected to permanently abandon nests, but may flush from nests. More significant effects result from exposure to predators as a result of flushing. This species relies largely on its cryptic coloration and concealment for protection from predators, and flushing from nests will alert predators to the location of the nest and leave eggs or chicks exposed. Startle responses to noises and associated visual stimuli are expected to result in an incremental reduction in nest success and/or chick survival. Knots are not expected to permanently abandon migratory stopover locations, but may flush from Wallops Island roosting or foraging locations, resulting in an expenditure of energy.

Atmospheric noise has been demonstrated to prevent loggerheads from entering an area (Manci et al. 1988). In the beach areas adjacent to rocket launch pads, the high intensity noise that occurs during rocket launches is expected to prevent loggerheads from coming ashore to nest. The intensity of noise close to launch pads is not expected to be sufficient to impair development of loggerhead eggs. Sand above the eggs is expected to attenuate the sound, but the degree of attenuation is not known. Noise is not expected to have an effect on loggerheads that come ashore to nest in habitat not located in the vicinity of the launch pads.

Effects on plover and knot from UAS flights, piloted aircraft operation, expansion of restricted airspace, range surveillance, and facility security

Jones et al. (2006) reported that wading birds were not disturbed by UAS overflights in excess of 328 ft above the birds. Similarly, Sarda-Parlomera et al. (2012) did not observe notable responses when they repeatedly overflew black-headed gull (*Chroicocephalus ridibundus*) colonies with small UAS at altitudes between 65 and 131 ft AGL. Most UAS flights originating from the north Wallops Island airstrip are expected to maintain at least 500 ft AGL except during landing and take-off (NASA 2012a). Therefore, UAS flights conducted from north Wallops Island airstrip have a minimal potential for disturbing plovers or knots to the level at which "take" would be expected.

Peak noise levels generated by aircraft at WFF range from 67 dB for a single-engine propeller airplane landing on Wallops Main Base to 155 dB for an F-18 conducting a touch and go maneuver at Wallops Main Base. Studies of the effects of helicopter overflight on waterbirds have shown (1) temporary behavioral response to low-altitude overflight, ranging from assuming an alert posture to taking flight; (2) responses decreasing in magnitude as overflight elevation increases; and (3) rapid resumption of the behaviors exhibited prior to the overflight (Komenda-Zehnder et al. 2003). Early research in Florida detected limited adverse effects when a helicopter overflew nesting waders (Kushland 1979). The majority of birds overflown did not exhibit any response to the stimulus and those that left their nests returned in less than 5 minutes. Smit and Visser (1993) found shorebirds and curlew to be particularly sensitive to helicopter overflights at less than 820 ft AGL, resulting in flushing of 33 – 75% of birds overflown, depending on the species. Flushing a bird from its nests can result in a range of adverse effects, from predation or abandonment of the chicks to energy expenditure of the parents.

Plovers may be disturbed by the operation of aircraft maneuvering or overflying the area where nesting occurs. Not all aircraft operation is likely to result in disturbance, and plovers are most likely to be disturbed by flights at low altitude down the beach or just offshore. Effects to plovers may include flushing from nests when incubating eggs, interruption of feeding or courtship, or similar responses. Effects to knots may include interruption of feeding or sheltering behaviors. Most noises are of short duration and plovers and knots are expected to return to normal behavior within a few minutes of the noise.

Effects on waterbirds can be reduced substantially if helicopters maintain minimum altitudes of at least 1,476 ft (Komenda-Zehnder et al. 2003). Birds may become habituated to aircraft overflight in an area of somewhat regular disturbance, such as the marshes between Wallops Main Base and Island or along the Wallops Island beach. Birds in more remote areas subject to surveillance flights, such as the barrier islands south of Wallops Island, could be more sensitive to overflights. NASA determined in their Biological Assessment that maintaining an altitude in excess of 1,476 ft will be possible for aircraft transiting from the Main Base airfield to an offshore surveillance area; however, aircraft conducting surveillance operations between Wallops Mainland and Island will be required to fly below 1,476 ft, which is expected to startle plovers and knots. Most noises are of short duration and plovers and knots are expected to return to normal behavior within a few minutes of the noise.

There is potential for a bird strike to occur (Washburn et al. 2014). Fifty-one percent of all bird strikes occur between September and February, during the months when plovers and knots are not expected to be present (Washburn et al. 2014). In addition, airfield activities conducted at Wallops Main Base are not expected to strike plovers or knots, as there is no suitable habitat present adjacent to the airfield. The new UAS airstrip is located in closer proximity to suitable habitat for plovers, although it will be located inland and away from nesting, foraging and roosting areas. The potential for plovers or knots to strike an aircraft is discountable.

The expansion of restricted airspace is likely to result in similar effects to those expected as a result of UAS and piloted aircraft operation, simply in an expanded area. There is no expected change to either the types of aircraft or the types and number of operations conducted within the airspace adjacent to WFF. As a result, the scale of overall impacts will not change, rather, they will be spread over a larger geographic area. Knots or plovers may be impacted by flights at low altitude or just offshore by disturbance to migrating behavior as described above.

Effects on plover, knot, and loggerhead from construction and routine facility maintenance

Construction will increase noise as a result of the presence of additional people and associated activities. Effects will be confined to the vicinity of the new fire station location adjacent to Navy Building V-024 and are not expected to result in more than minor behavioral responses from all 3 species.

Road resurfacing and infrastructure replacement will use heavy equipment and may elicit a startle response causing plovers and red knots to cease normal behaviors temporarily until noise has stopped in response to increased noise. Effects to loggerheads are unlikely as infrastructure projects are not located in proximity to areas used for nesting attempts.

Routine repairs are often required after hurricanes or intense storms. Heavy equipment is used to clear roads and stormwater systems. Activities conducted away from the beach are less likely to affect listed species. Maintenance activities on the beach are likely to create a startle response and may cause plovers or knots to temporarily cease foraging or resting and plovers may temporarily cease nesting. These activities are not expected to be intense or sustained enough to adversely affect plovers or knots.

Effects of noise from construction and routine maintenance to plovers may include flushing from nests when incubating eggs, interruption of feeding or courtship, or similar responses. Effects to knots may include interruption of feeding or sheltering behaviors. Most noises are of low intensity but long duration and plovers and knots are expected to habituate to the noise and return to normal behavior over time.

Vibration

Effects on plover, knot, and loggerhead from liquid fueled ELV launches, solid fueled ELV launches, ELV static fires, sounding rocket launches, sounding rocket static fire testing, drone target launches, UAS flights, piloted aircraft flights

Some energy from rocket launches, static tests, drone target launches, UAS flights, and piloted aircraft flight on Wallops Island will manifest as vibration in the ground near the launch pad or airstrip. Vibration may be significant from rocket launches, engine tests, and open burns. Effects from vibrations are likely to be confined to an additive disturbance to adult plovers, adult knots, and nesting loggerheads that may cause birds and turtles to temporarily cease normal behaviors. Due to the distance between rocket launch sites and nesting habitat for plovers and loggerheads, it is unlikely that vibrations will be significant enough to affect egg viability. Vibration at other NASA launch facilities has not been demonstrated to harm bird or sea turtle eggs (NASA 2009). Impacts from noise during launches can extend over 6 mi (NASA 2019), so vibration will likely radiate from the launch pads in a similar fashion and dissipate with increasing distance from the launch site. To aid with controlling vibrations from launch at liquid-fueled LV launch pad a deluge system is used. Given that loggerhead nesting has been documented less than 1 mi from the launch pads and plovers are known to nest and feed within 6 mi of the launch site, vibrations may affect egg viability for plovers and loggerheads nesting within the new beach. Knot activity in the vicinity of Launch Complex 0 is low; therefore effects to knots from vibration are unlikely.

Rocket Exhaust

Effects on plover, knot, and loggerhead from liquid fueled ELV launches, solid fueled ELV launches, ELV static fires, sounding rocket launches, sounding rocket static fire testing, disposal of waste rocket motors, drone target launches

Rocket exhaust from Pad 0-B is directed over the Atlantic Ocean by a vent located in the base of the gantry. Exhaust from launches and static tests at Pad 0-A is directed over the Atlantic Ocean through a flame trench in the launch pad. Wildlife within 656 to 984 ft of the exhaust ports during engine ignition may be harmed or killed. Plovers, knots, or loggerheads exposed directly to the exhaust could be killed by hot gas or by caustic combustion products. To be exposed, birds would need to be flying through the path of the exhaust plume at the time of ignition. Rockets leave the pad within seconds and the contrail stays with the launch vehicle. The solid-fueled LV launch pad has a flame trench that directs the flame over the ocean. The liquid-fueled LV launch pad has a deluge system that that suppresses flames and vibrations on the pad. Given the distribution of knot and plover habitat north and south of the launch complex and the likelihood that individual plovers will move around while establishing breeding territories or feeding and a plover or knot will likely pass through the area during migration, plovers and knots may be harmed due to rocket exhaust, but the likelihood of this occurring is low. In 2013, a loggerhead nest was located just north of Pad 0-A suggesting that loggerheads may nest in proximity to the launch pads in the future and hatchlings or adults may be harmed by hot exhaust.

The combustion of solid fuel rocket boosters creates aluminum oxide. Aluminum oxide particles in the atmosphere are efficient scavengers of water vapor and hydrogen chloride, and these particles produce hydrochloric acid. The combination of atmospheric and oceanic dilution, the buffering capacity of the ocean, and the presence of salt-laden soils in the adjacent areas will prevent hydrochloric acid from impacting pH of habitats within the Action Area. Hydrogen chloride vapor may exist in hazardous quantities in the immediate vicinity of launch pad 0-B at the completion of a launch. "The rapid dissolution of hydrogen chloride in the ambient air would result in a decline of this concentration within 60 minutes to a nonhazardous level (ATCA 2012)" (NASA 2019). A plover or knot flying through the area could be exposed to a caustic cloud of such vapor; however the disturbance of the launch event itself will likely repel birds from the immediate area for some time after engine ignition. Therefore, hydrochloric acid is not expected to adversely affect plovers, knots, or loggerheads (NASA 2005, 2009).

Estimates of carbon monoxide concentrations on the beach at the south end of Wallops Island following a launch or static test at either pad in Launch Complex 0 are between 0.9 and 1.1 parts per million, depending on weather conditions. These are below human exposure thresholds and believed to be below observable effects thresholds in wildlife. Atmospheric mixing and conversion of carbon monoxide to carbon dioxide will quickly diminish these concentrations; therefore, the concentration of carbon monoxide is not expected to adversely affect plovers, knots, or loggerheads (NASA 2005, 2009).

Lighting

Effects from liquid fueled ELV launches, solid fueled ELV launches, ELV static fires, sounding rocket launches, sounding rocket static fire testing, drone target launches, UAS flights, piloted aircraft flights, construction, launch pad lighting

Plover and knot – Rockets staged at Launch Complex 0 are up lit with metal halide lighting for up to several weeks prior to and up to 24 hours following a launch. Other structures within the launch complex, as well as Payload Fueling Facility, Payload Processing Facility, and Horizontal Integration Facility, use amber light emitting diodes or low pressure sodium bulbs for exterior night lighting. Additional lighting may also be used during construction of new facilities. Most of the existing and new facilities are not located immediately adjacent to the beach, which limits the potential effects on listed bird species; however, they do contribute to elevated levels of ambient lighting with the proximity of several facilities to the beach habitat.

Anthropogenic lighting attracts migrating birds, especially during times of reduced visibility. Effects can range in intensity from collision with structures resulting in injury or mortality, to lesser effects including expenditure of energy or delay in arrival at breeding or wintering grounds (Gauthreaux and Belser 2006). The majority of Atlantic Coast piping plover migratory movements are thought to take place along a narrow flight corridor, including the outer beaches of the coastline, with rare offshore and inland observations (Service 1996). Plover visual acuity and maneuverability are known to be good (Burger et al. 2011), including night vision (Staine and Burger 1994), suggesting that plovers may be able to identify and avoid structures in their flight paths. Plover collisions with fixed structures in the coastal zone are rarely documented (Service 2008); however, inclement weather could increase attraction to structures and collision risk (Richardson 2000).

Migrating knots may be exposed to similar risks. Burger et al. (2011) report knot migration flights occurring at altitudes between 0.6 and 1.8 mi AGL, well above the structures on Wallops Island. The most serious risk is likely to occur when northbound long-distance migrants make landfall at foraging areas. Wallops Island is a known stopover site for northerly migrating knots; however, the high-use areas are located well north of the Wallops Island infrastructure that may pose a risk to birds landing to rest or forage, resulting in a low likelihood of collision. Southbound migrants are at comparatively less risk due to their farther offshore flight paths. Although visual acuity and maneuverability of knots are known to be good (Burger et al. 2011, Cohen et al. 2011), inclement weather conditions could increase collision risk due to attraction to lighted structures (Richardson 2000).

<u>Loggerhead</u> – Anthropogenic light sources have documented negative effects on sea turtles. Unshielded lights can deter females from crawling onto a beach to nest. Bright full-spectrum or white lighting within view from the beach can cause female sea turtles to abandon nest attempts (Witherington 1992). At hatching, juveniles emerge and seek the nearest available light source, which on an undeveloped beach is the horizon over the ocean. Bright full-spectrum or white lighting shining in the vicinity of a nest can disorient emerging hatchlings, leading them away from the ocean and leaving them more vulnerable to predation, desiccation, or crushing by vehicles (Witherington and Bjorndal 1991). Hatchlings that reach the surf can become disoriented by lighting and leave the surf (Witherington 1991, NMFS and Service 2007).

This type of lighting is present at both the launch pads and airstrips, however, only the launch pads are in close proximity to nesting habitat. Therefore, any adults or hatchlings in this area during the approximately 4 weeks/launch that night-time lighting is being implemented would be affected by lighting.

UAS flights are occasionally conducted at night in response to special circumstances or for hurricane monitoring. Safety lighting at the airstrip will be minimal intensity and downward shielded, and over flying UAS will not use running lights. Therefore, UAS flights are not likely to adversely affect loggerheads.

Disturbance

Effects on plover, knot, and loggerhead from facility security, recreational/ORV beach use, and miscellaneous activities on and education use of Wallops Island beach

WFF personnel and their families are allowed to use the north end of Wallops Island for recreation outside of NASA operations periods. Recreational use, miscellaneous maintenance activities and security patrols conducted on the beach have similar effects on listed species because they may involve operation of vehicles or heavy equipment on the beach, in addition to people on foot in areas where plovers, knots, or loggerheads may occur. Security patrols have been ongoing at WFF for a number of years, and have likely presented some level of disturbance to plovers and nesting loggerheads.

<u>Plover</u> – Effects of foot traffic to nesting plovers can range from relatively minor disturbance that temporarily interferes with normal breeding, feeding, and sheltering behavior causing harm or death of chicks, or sustained disturbance resulting in nest abandonment. Vehicle use on the beach can crush chicks and create ruts capable of trapping plover chicks where they can die or be eaten by a predator.

Closure of a plover nesting area will avoid these effects to the extent that the closure is observed; however, plovers may nest outside of the established closure area. In these cases, monitoring, placing nest exclosures, and posting signage will minimize effects to the identified nests. After hatching, young plovers are likely to move away from nesting areas, making them vulnerable to these effects throughout a much larger area. Even with surveys and monitoring conducted at a high frequency, young plovers may be killed or harmed due to their coloration causing them to blend in with the sand and their tendency to freeze when frightened in order to rely on this camouflage. Plovers that migrate along the barrier islands between wintering grounds and breeding grounds may also be impacted by human activity and vehicle use interfering with their ability to forage. Vehicles and human activity may make prey difficult to access by blocking habitat or compacting the sand. Additionally, noise may also discourage the use of the habitat.

<u>Loggerhead</u> – Security patrols and recreational use may inadvertently disturb nesting females, crush eggs within the nest, or crush, entrap, or disturb hatchlings attempting to leave the nest. Vehicle use on the beaches may compact beach sand and/or disturb female turtles attempting to nest, however, monitoring for turtle activity followed by erecting exclosures to protect nests will avoid adverse impacts due to the low level of nesting activity exhibited at Wallops Island.

<u>Plover and loggerhead</u> – Effects to plovers and loggerheads are likely to include an increased predation rate due to human activity. Human activity may result in trash on the ground, which could both attract predators and increase the carrying capacity of the predators due to increased food availability. The increased numbers of predators may increase risk of disturbance, nest loss, and adult mortality of plovers and increase losses of loggerhead eggs and nests. Plovers may expend more energy in predator surveillance and avoidance and that energy expenditure could decrease overall fitness. However, use of these sites for recreation and security patrols is generally light and not continuous; therefore effects to plovers and loggerheads are expected to be minimal.

<u>Knot</u> – Both recreational and operational uses of Wallops Island beach have the potential to disturb foraging and resting knots. The presence of vehicles on the beach has been shown to result in fewer individuals as compared to an area without the disturbance, as affected shorebirds shift their preferred habitat (Pfister et al. 1992). A study in Massachusetts suggests that knots

may be more susceptible to human disturbance (based on pedestrian induced flight-initiation distance) than other species commonly found on the beach during spring migration (Koch and Paton 2014). In Virginia, Watts and Truitt (2015) demonstrated that the majority of knots are only present on the barrier islands for an approximately 4 to 5 week period in late spring.

Therefore, although knots could be exposed to beach use-induced stressors in the Action Area, impacts will be for a short duration. In addition, the majority of north Wallops Island is closed to recreational use (NASA 2015b) during the plover nesting season (April 15 to August 31), corresponding to the location on Wallops Island where a majority of knots have been observed in recent years. Additionally, Schlacher et al. (2008) demonstrated *Donax* spp. mortality when exposed to vehicle traffic; however, vehicle use at Wallops Island is far less than the area studied and impacts are not expected to be significant. Therefore, the knot is not expected to be adversely affected by alterations to its foraging base from facility security, recreational/ ORV beach use or miscellaneous activities on or education use of Wallops Island beach.

Effects on plover, and knot from protected species management and shoreline reconstruction monitoring

Monitoring activities involve conducting frequent surveys, implementing area closures and posting signage, placing plover nest enclosures, and similar actions. The intent of monitoring activities is to reduce or avoid impacts to listed species by detecting them early. Movement by personnel through the habitat during monitoring efforts is not likely to adversely affect plovers and knots.

Effects on plover, knot, and loggerhead from seawall repair and post-renourishment work

The operation of heavy equipment and presence of personnel on the beach in conjunction with seawall repair will result in disturbance to plovers and knots using the area for foraging or passing through the area while moving among foraging areas. Any plovers or knots using these areas are expected to temporarily cease normal foraging, roosting, or flight behavior and fly to adjacent suitable areas where there is no disturbance, or alter their flight paths to avoid areas where activity is occurring. Similarly, during the nesting season loggerheads may be temporarily disturbed by onshore activities and move to other nearby areas where there is no disturbance. However, habitat quality for plovers and knots in degraded shoreline areas where seawall repair will be occurring is low, so these species are not expected and these effects are expected to be insignificant and discountable. Habitat quality for loggerheads is also expected to be low, but loggerheads may attempt to nest in these locations. See above for further discussion on effects of renourishment on loggerheads.

Operation of the dredge is limited to offshore areas and will not affect the shoreline beyond delivery of sand; therefore, it will not affect the species considered in this opinion under the Service’s jurisdiction. Effects to loggerheads at sea are addressed separately through NASA’s section 7 consultation with NMFS.

After each renourishment cycle, shortly after construction of the beach and dune, beachgrass planting (discussed above) and sand fence installation will be conducted on the seaward side of the dune adjacent to the new beach. Depending on timing of sand fence installation, the increased presence of people on the beach may result in disturbance to plovers and knots. This disturbance is expected to cause plovers and knots to flush and move to other areas. The installation of sand fencing is not expected to affect loggerheads because these activities will be conducted during the day and loggerheads are expected to be in close proximity to the beach during the night hours.

Once installed, the presence of sand fence may deter plover nesting close to the sand fence and may increase the risk of depredation by providing cover for predators in close proximity to plover nests. Migrating knots generally do not use the renourished beach for feeding and do not nest in Virginia; therefore, the presence of sand fence is not expected to affect knots. The sand fence is expected to allow movement of adult loggerheads above the berm and into the dune area and will not prevent them from returning to sea. If nests are located landward of the sand fence a small fraction of hatchling turtles may become trapped, particularly if the sand fence is not maintained or if debris entangled in the sand fence prevents hatchling movements.

Habitat Loss/Suitability

Effects from beach renourishment by offshore shoal

<u>Plover</u> – The addition of sand dredged from offshore shoal A or B may result in a beach similar in appearance to a natural beach, but significantly different in sand density and compaction, grain size and assortment, and beach-associated fauna, including invertebrates, and nutrients and chemical characteristics of the sand. Immediately following sand placement, the suitability of the renourished beach for plovers is expected to be significantly less than a natural beach of similar size and configuration due to loss of invertebrate prey.

Over time, the faunal characteristics of a natural beach are expected to return as the created beach is recolonized by beach-associated fauna and plants, and as wave action, wind, rain, and other natural forces weather the beach (National Research Council 1995). After recolonization of the beach by invertebrates, the beach may become higher quality foraging habitat for plovers than surrounding natural beaches because the beach will remain free from vegetation for a period of time (Melvin et al. 1991) and may be higher and wider than nearby eroding beaches.
NASA monitoring data (NASA 2012b, 2013, 2014a, 2015b, 2016, 2017, 2018) shows that the number of plover nests is fairly consistent from year-to-year, suggesting that beach renourishment from an offshore shoal does not cause a decrease in the number of plover breeding territories on Wallops Island but that plovers may preferentially nest on north Wallops Island. Monitoring data shows that plovers nested on the renourished beach after 2 years (NASA 2014a, 2015b). Beach renourishment using sand excavated from an offshore shoal is expected to occur approximately once every 2 – 7 years. Due to nesting habitat on north Wallops Island no

longer being available due to backpassing, renourishment in the template identified in Figure 3 will result in a reduction in nesting success and survival on Wallops Island.

<u>Knot</u> – The area of Wallops Island beach that historically hosted the greatest number of knots during the northern migration – the north "curve" – is rapidly accreting but overlaps the beach renourishment area (King et al. 2011). If sand is obtained from offshore shoal A or B and placed in the renourishment area outlined in the reinitiated action, then impacts are expected to be the same as those addressed in Table 7.

<u>Loggerhead</u> – Based on the large grain size of the sand from shoals A and B, the relatively long distance from the water line to the berm/dune interface where turtles would be expected to nest, and the placement of sand over and around the rock seawall for most of the project area, desiccation of the beach is expected because the sand will likely drain quickly, the rock seawall will interfere with maintaining a natural moisture gradient, and the area may be infrequently affected by waves inundating any nests impacting nest success. The sand color is expected to be similar to that which occurs on the beaches of the area because the material that occurs in the offshore shoals is eventually transported to the beaches and likely originates from the same material as that which occurs on the beach.

The gender of sea turtles is determined by temperature during the middle third of the incubation period, with only a few degrees separating the production of male and female hatchlings (Conant et al. 2009). Therefore, even slight differences in sand color, grain size, and moisture that affect sand temperatures and alter the ratio of males to females produced. The sand is expected to show less cohesiveness and lower shear strength than sand found on natural beaches, which may reduce the ability of nestlings to dig themselves out of the nest (egg chamber).

<u>Plover, knot, and loggerhead</u> – Following placement of sand from an offshore shoal on the beach and dune, some portion of this material will be transported onto natural beaches adjacent to the project area. Natural wind and current patterns are likely to transport sand to the north and deposit it on north Wallops Island and portions of CNWR, and also to the south, where it will be deposited on Assawoman Island. The amount and degree of deposition on these islands is dependent on environmental conditions (e.g., storms, wave action), effects of breakwaters, and other factors that may affect littoral sand transport. Over time, the deposition of the relatively large sand grains will affect mean sand grain size and other physical characteristics of these beaches. While the grain size of the two most recent renourishment matched the grain size on Wallops Island, there is potential for this to differ for future renourishments. These changes may either improve or reduce the suitability of unnourished beaches for plover nesting and foraging, knot foraging, and loggerhead nesting. The impacts of mismatched grain sizes were shown on Assateague Island, when sediment with a higher proportion of coarse grained sediment was used. The coarse sediment prevented the mobilization of the finer sediments, degrading habitat suitability for plovers (Schupp et al. 2013). These changes may shift the areas that plovers and knots use for foraging, or that plovers and loggerheads use for nesting but total area used by these species is not likely to change.

The sand placed on the renourished beach from the offshore shoal will initially be unsuitable for use by invertebrates and plants characteristic of natural beaches and much of the fauna on the beach will be killed or negatively impacted by the renourishment. The beach conditions are expected to be completely unsuitable for use by nesting plovers and loggerheads during the first year following sand placement, with limited amounts of suitable habitat available 1 year following placement, and returning to conditions similar to those that existed prior to placement by 3 years following placement.

Additive Effects of Proposed Activities

In addition to the effects of the proposed actions considered and described above, the additive effects of the different types of activities result in greater impacts than each activity conducted independently. For example, operations of UAS within the parameters described may result in infrequent disturbance and some launch operations, rocket tests, and monitoring may have similar effects. The combination of all of these activities, when considered together, results in more frequent disturbance and as a result we expect plovers and loggerheads to experience low levels of disturbance in the Action Area on a regular basis.

Frequent disturbance to plovers, knots, and loggerheads resulting from mission preparation and support may disturb the species to the extent that they avoid use of the south end of Wallops Island where mission-related activities are concentrated. If they avoid use of the area, listed species may not be subjected to the most intense and severe effects expected to occur during rocket launches. In addition, because the suitability of the newly created beaches is expected to be relatively low for a period following sand placement, use by plovers and loggerheads may be reduced and as a result some of the most severe effects resulting from launches may be reduced. However, because some nesting loggerheads and migrant plovers and knots use the beach only for limited periods of time, frequent disturbance and/or low habitat suitability is not expected to completely prevent the most severe effects from occurring.

CUMULATIVE EFFECTS

Cumulative effects are those "effects of future State or private activities, not involving federal activities, that are reasonably certain to occur within the action area" considered in this Opinion (50 CFR 402.02). The Service is not aware of any future state, tribal, local, or private actions that are reasonably certain to occur within the Action Area at this time; therefore, no cumulative effects are anticipated.

JEOPARDY AND ADVERSE MODIFICATION ANALYSIS

Section 7(a)(2) of the ESA requires that federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat.

Jeopardy Analysis Framework

"Jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR 402.02). The following analysis relies on 4 components: (1) Status of the Species, (2) Environmental Baseline, (3) Effects of the Action, and (4) Cumulative Effects. The jeopardy analysis in this Opinion emphasizes the rangewide survival and recovery needs of the listed species and the role of the Action Area in providing for those needs. It is within this context that we evaluate the significance of the proposed federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

Analysis for Jeopardy

Plover

Impacts to Individuals – The proposed action includes impacts to nesting, foraging, and roosting habitat from the proposed SERP and activities described in the 2016 Wallops Flight Facility Update and Consolidation of Existing Biological Opinions that have not have changed, evaluated over a 15 year timeframe. As discussed in the Effects of the Action, potential effects of the action include effects to plovers present within the Action Area during spring migration and nesting season with some of the actions affecting plovers for subsequent migration and nesting seasons following initial construction. Effects generally include loss of nesting and foraging habitat, disturbance, habitat degradation, increased human activity, reduction in prey populations, and physical impacts such as crushing individuals. We anticipate that all individuals attempting to nest or forage on Wallops Island will be impacted -- ranging from 3-9 nesting pairs per year from 2010-2018 and 1-2 additional birds that nest in areas south of Wallops Island and forage on the south end of Wallops Island in the area near camera stand Z-100. The loss of habitat may cause individuals to seek out habitat elsewhere, resulting in additional competition for territories, and/or use of suboptimal habitat, resulting in decreased productivity and survival. While backpassing and renourishment activities will not begin prior to fledging of the 2019 season's chicks, effects will impact individuals returning to the area during the 2020 migration and nesting season and subsequent seasons depending on recovery time of the habitat. The habitat may remain suboptimal until the benthic community has recovered and sediment dynamics stabilize available nesting habitat on the island, which could take up to 6 years based on current models (Corps 2018a, 2018b). In summary, we anticipate impacts to individual plovers in either their annual survival or reproductive rates.

Impacts to Populations – As we have concluded that individual plovers are likely to experience impacts in their annual survival or reproductive rates, we need to assess the aggregated consequences of the anticipated impacts on the population to which these individuals belong. The nesting plover population on Wallops Island made up an average of 2.3% of nesting pairs, as of 2016, within the Southern RU. Loss of carrying capacity of breeding habitat on Wallops Island and loss of potential for growth in the abundance of breeding pairs from Wallops Island needed to attain recovery in this RU will continue for the life of the project. During this time, nesting will continue, but at a reduced frequency and at a lower number of nests in some years. Because the Wallops Island nesting population will not be permanently lost and represents a relatively minor (2.3%) portion of the nesting pairs in the Southern RU, we conclude that the effects from the proposed action will not result in permanent population declines in this RU.

Impacts to Species – To understand the consequences of population-level effects at the species level, we need to understand the RND needs of the species. Because recovery units have been designated for the plover, we first will assess the consequences of these impacts at the recovery unit level. As discussed in the Status of the Species, there are 4 recovery units – each with an overall productivity target and their own breeding pair target to either achieve or maintain over a 5 year period: Atlantic Canada, 400 pairs; New England, 625 pairs; New York-New Jersey, 575 pairs; Southern (DE-MD-VA-NC), 400 pairs (Service 1996). While the Southern RU status is classified as improving (Service 2017), declining productivity was observed in the 2016 and 2017 nesting seasons with a small increase in 2018 (Service 2019a). This project is not anticipated to change the Southern RU status as the nesting population on Wallops Island accounted for approximately 2.3% of nesting pairs within the RU, as of 2016. Wallops Island will continue to contribute to the Southern RU at a reduced amount that is not expected to impact the rangewide status of the species.

CONCLUSION

We considered the current overall improving rangewide status of the plover and the stable condition of the species within the Action Area (environmental baseline). We then assessed the effects of the proposed action and the potential for cumulative effects in the Action Area on individuals, populations, and the species as a whole. As stated in the Jeopardy Analysis, we do not anticipate any reductions in the overall RND of the plover. It is the Service's Opinion that the actions addressed in the Wallops Flight Facility Update and Consolidation of Existing Biological Opinions, as proposed, are not likely to jeopardize the continued existence of the plover.

<u>Knot</u>
Impacts to Individuals – The proposed action includes impacts to foraging and roosting habitat from the proposed SERP and activities described in the 2016 Wallops Flight Facility Update and Consolidation of Existing Biological Opinions that have not have changed, evaluated over a 15 year timeframe. As discussed in the Effects of the Action, potential effects of the action include effects to knots present within the Action Area during spring migration with some of the actions affecting knots for subsequent seasons following initial construction. Effects generally include loss of foraging and roosting habitat, disturbance, habitat degradation, and loss of prey species. Flocks of knots ranging in size from 34-1,162 individuals have been documented on Wallops Island (NASA 2010b, 2011, 2012b, 2013, 2014a, 2015b, 2016, 2017, 2018). During some years of the 15-year Opinion timeframe, we anticipate that all individuals attempting to forage and

roost on Wallops Island will be impacted and attempt to seek habitat elsewhere. Searching for alternative suitable habitat leads to increased energy expenditure from additional search times and increases exposure to predators. Additionally, suboptimal habitat may have more predators, thus increasing predation risk. Use of suboptimal habitat may also result in lower weight when reaching the Arctic leading to reduced reproductive success. While construction will not begin until after the 2019 spring knot migration, the effects stated above will impact individuals returning to the area during the 2020 spring migration and subsequent migration seasons. Following construction, the habitat may remain suboptimal until the benthic community returns and sediment dynamics stabilize, which could take up to 6 years based on current models (Corps 2018a, 2018b). In summary, we anticipate impacts to individual knots in either their annual survival or reproductive rates.

Impacts to Populations – As we have concluded that individual knots are likely to experience impacts in their annual survival or reproductive rates, we need to assess the aggregated consequences of the anticipated impacts on the population to which these individuals belong. While a rangewide population estimate is not available (Service 2019b), the Eastern Shore of Virginia has been known to support a population of approximately 7,000 knots with variation in numbers of individuals (Cohen et al. 2009, Karpanty et al. 2018). The knot flocks documented at Wallops Island of 34-1,162 individuals indicate that a maximum of 16.6% of migratory knots along the Eastern Shore are utilizing Wallops Island. It is unlikely that all 16.6% of knots will be affected every year from harm and decreased reproduction on their Arctic breeding grounds because knots are not foraging and roosting exclusively on Wallops Island during their spring migration and habitat will be available on Wallops Island, although not during all years and at a reduced level of quality, in some years during the Opinion timeframe. While the proposed action affects a single active foraging area along Virginia's Eastern Shore and impacts will be felt over multiple years, we conclude that the effects will not result in permanent population declines.

Impacts to Species – As we have concluded that knot populations are unlikely to experience reductions in fitness, there will be no harmful effects (i.e., there will be no reduction in RND) on the species as a whole.

CONCLUSION

We considered the current overall stable rangewide status of the knot and the variable condition of the species within the Action Area (environmental baseline). We then assessed the effects of the proposed action and the potential for cumulative effects in the Action Area on individuals, populations, and the species as a whole. As stated in the Jeopardy Analysis, we do not anticipate any reductions in the overall RND of the knot. It is the Service's Opinion that the actions addressed in the Wallops Flight Facility Update and Consolidation of Existing Biological Opinions, as proposed, are not likely to jeopardize the continued existence of the knot.

<u>Loggerhead</u>
Impacts to Individuals – The proposed action includes impacts to nesting habitat from equipment

staging, sand stockping, operation of equipment both day and night, sand mining, and renourishment from the proposed SERP and activities described in the 2016 Wallops Flight Facility Update and Consolidation of Existing Biological Opinions that have not have changed, evaluated over a 15-year timeframe. As discussed in the Effects of the Action, potential effects of the action include effects to loggerheads present within the Action Area during nesting season with some of the actions affecting loggerheads for subsequent nesting seasons following initial construction. Effects generally include loss of nesting habitat, disturbance, habitat degradation, and physical impacts such as crushing individuals. We anticipate that all individuals attempting to nest on Wallops Island will be impacted during some years of the 15-year Opinion timeframe. While construction will not begin prior to hatching of the 2019 seasons nests, the effects stated above will impact individuals returning to the area during the 2020 nesting season and subsequent seasons. Following construction, the habitat may remain suboptimal until sediment dynamics stabilize, which could take up to 6 years based on current models. In summary, we anticipate impacts to individual loggerheads in either their annual survival or reproductive rates.

Impacts to Populations – As we have concluded that individual loggerheads are likely to experience impacts in their annual survival or reproductive rates, we need to assess the aggregated consequences of the anticipated impacts on the population to which these individuals belong. From 1974-2017, 13 loggerhead nests and 22 false crawls were documented on Wallops Island. Nesting does not occur every year on Wallops Island and in 2010 all nests were laid by 1 female (NASA 2010b). Given that limited nesting occurs and that in some years nesting habitat will be available, we expect that the population level impacts from decreased reproduction, harm, and death will be relatively minor and will not occur every year. We conclude that the effects will not result in permanent population declines.

Impacts to Species – As we have concluded that loggerhead populations are unlikely to experience reductions in fitness, there will be no harmful effects (i.e., there will be no reduction in RND) on the species as a whole.

CONCLUSION

We considered the current overall declining rangewide status of the loggerhead and the stable condition of the species within the Action Area (environmental baseline). We then assessed the effects of the proposed action and the potential for cumulative effects in the Action Area on individuals, populations, and the species as a whole. As stated in the Jeopardy Analysis, we do not anticipate any reductions in the overall RND of the loggerhead. It is the Service's Opinion that the actions addressed in the Wallops Flight Facility Update and Consolidation of Existing Biological Opinions, as proposed, are not likely to jeopardize the continued existence of the loggerhead.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. Take is defined in section 3 of the ESA as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering (50 CFR § 17.3). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are nondiscretionary, and must be undertaken by NASA so that they become binding conditions of any grant or permit issued to any applicant, as appropriate, for the exemption in section 7(o)(2) to apply. NASA has a continuing duty to regulate the activity covered by this incidental take statement. If NASA (1) fails to assume and implement the terms and conditions or (2) fails to require NASA to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of Section 7(o)(2) may lapse. To monitor the impact of incidental take, NASA must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR 402.14(i)(3)].

AMOUNT OR EXTENT OF TAKE ANTICIPATED

Numeric Estimate of Anticipated Incidental Take/Use of Surrogate for Monitoring Take

The Service has used available data to quantify and numerically express anticipated incidental take of plovers, knots, and loggerheads. This numerical estimate provides a clear limit on the incidental take anticipated and authorized in this Opinion. However, based on the difficulties associated with monitoring take in terms of affected individuals, the Service also provides an additional, alternative means of monitoring take of plovers, knots, and loggerheads. This approach is most protective of plovers, knots, and loggerheads in that reinitiation is triggered if the incidental take from the project exceeds the number of plovers, knots, or loggerheads specified below or exceeds, in any amount or manner, the surrogates specified below.

50 CFR 402.14(i)(1)(i) states that surrogates may be used to express the amount or extent of anticipated take provided the Opinion or incidental take statement: (1) describes the causal link between the surrogate and take of the listed species; (2) describes why it is not practical to express the amount of anticipated take or to monitor take-related impacts in terms of individuals of the listed species; and (3) sets a clear standard for determining when the amount or extent of the taking has been exceeded.

In situations where some data exists that may be used to calculate a numerical estimate of take for a species but there are challenges associated with measuring take in terms of individuals, the Service has used surrogates as an additional means of monitoring take. In those instances, project effects outside of a specifically defined amount of affected surrogate serves as a trigger indicating that the numerical take estimate may have been exceeded and reinitiation is required.

Plover – Numeric Estimate of Anticipated Incidental Take

The numerical estimates of incidental take below were calculated using plover productivity data from Wallops Island. From 2012-2018 average productivity, represented by the number of chicks fledged per pair each year, was 1.05 chicks fledged/pair. The number of nests each year ranged from 3 to 9 with an average of 5.4 nests/year.

Backpassing and Renourishment – Plovers have been documented using 3.1 linear mi of beach habitat on Wallops Island for nesting and foraging. Of these 3.1 linear mi of habitat, 1.8 linear mi will be removed via sand mining, which includes operation of heavy equipment (day and night) and presence of additional personnel, and will take up to 6 years to return to its current habitat quality and quantity. The remaining 1.3 linear mi of habitat will be renourished, rendering it unusable during renourishment due to operation of heavy equipment (day and night) and presence of additional personnel or suboptimal post-renourishment due to burial and loss of benthic organisms for approximately 1 year.

Since the 3.1 linear mi of habitat will be unusable or suboptimal for 1 year, we expect that all adults and chicks will be incidentally taken (5 nests/year x 2 adults/nest = 10 adults) + (5 pairs x 1.05 chicks fledged/pair = 5.25 = 5 chicks) + (2 foraging adults), for a total of 17 birds (12 adults and 5 chicks). Additionally, on average 71% of nests (71% of 5 nests = 3.55 = 4 nests) are laid each year in the 1.8 linear mi where sand is to be excavated. To account for the additional 5 years needed for this area to recover to current habitat quality and quantity, take of 50% of all adults and chicks is anticipated in the first 2 years after backpassing as birds return to the area and no nesting or foraging habitat is available (4 nests x 2 adults/nest = 8 adults) + (4 pairs x 1.05 chicks fledged/pair = 4.20 = 4 chicks) and (8 adults + 4 chicks x 50% = 6 birds x 2 years = 12 birds). No take is anticipated in the last 3 years due to gradual return of habitat.

As backpassing and renourishment, which includes operation of heavy equipment (day and night) and presence of additional personnel, are expected to occur again in 10 years, 20 adults (12 adults in year 1 + 4 adults in year 2 + 4 adults in year 3) and 9 chicks (5 chicks in year 1 + 2 chicks in year 2 + 2 chicks in year 3) are expected to be taken when this action occurs again. Over the 15-year Opinion timeframe, the Service expects a total of 58 plovers (40 adults and 18 chicks) to be incidentally taken due to backpassing and renourishment.

Renourishment using an offshore shoal will take place every 2-7 years between backpassing events. We are assuming that renourishment will occur in 2-year intervals during the 15-year Opinion timeframe. Twenty-nine percent of nests are laid each year in the 1.2 linear mi section of the north end of the renourishment area. We expect that all adults and chicks in this area will be incidentally taken with each renourishment event (29% of 5 nests = 1.45 = 1 nests) (1 nests x 2 adults/nest = 2 adults) (1 pair x 1.05 chicks fledged/pair = 1.05 = 1 chick) + (2 foraging adults).

Using a 2-year interval, we are assuming 6 renourishment events during the 15-year Opinion timeframe (6 renourishment events x 4 adults per event = 24 adults) (6 renourishment events x 1 chick per event = 6 chicks). Over the 15-year Opinion timeframe, the Service expects a total of 30 plovers (24 adults and 6 chicks) to be incidentally taken due to renourishment using an offshore shoal. The anticipated take is described in Table 9.

Recreational Beach Use – Recreational beach use, including foot traffic and vehicle use, occurs each year. Incidental take of 1 pair (2 adults) and 1 nest (1 pair x 1.05 chicks fledged/pair = 1.05 = 1 chick) is anticipated each year. Over the 15-year Opinion timeframe, the Service expects 30 adults and 15 chicks to be incidentally taken due to recreational beach use. The anticipated take is described in Table 9.

Rocket Launches and Flights – From 2012-2018, nesting plovers on Wallops Island laid an average of 3.58 eggs/pair. Incidental take of 1 pair (2 adults) and 1 nest (1 pair x 1.05 chicks fledged/pair = 1.05 = 1 chick or 1 pair x 3.58 eggs/pair = 3.58 = 4 eggs) is anticipated each year from the effects of launch-related activities immediately adjacent to the beach, resulting from intense sound, exposure to rocket exhaust and contaminants, collision with aircraft, and similar launch activities. Over the 15-year Opinion timeframe, the Service expects 30 adults and 15 chicks or 60 eggs to be incidentally taken due to rocket launches and flights. The anticipated take is described in Table 9.

Plover – Surrogate for Monitoring Take

It is not practical to monitor take-related impacts in terms of individual plovers for the following reasons: the species has a small body size making it difficult to locate, which makes encountering dead or harmed individuals unlikely; species losses may be masked by annual fluctuations in numbers; take may occur offsite; failure to reproduce or a decrease in nesting productivity may not be detected if an individual moves to a neighboring island; some forms of take are non-lethal harm that is not detectable. Detecting mortality or harm of plovers (especially chicks), particularly on beaches where vehicles are being operated, is extremely difficult. Cryptic coloration is the species' primary defense mechanism, evolved to cope with natural predators, and nests, adults, and chicks blend with beach surroundings. Newly hatched chicks stand 2.5 inches high, weigh less than a quarter ounce, blend with the beach substrate, and often respond to approaching vehicles, pedestrians, and perceived predators by "freezing" in place to take advantage of their natural camouflage. Dead chicks may be covered by wind-blown sand, ground into the sand by other passing vehicles, washed away by high tides, or consumed by scavengers.

Backpassing and Renourishment – Linear miles of beach habitat where plovers nest and forage is being used as a surrogate to express the extent of authorized take for the plover related to backpassing and renourishment activities, which includes operation of heavy equipment (day and night) and presence of additional personnel, because it is not practical to monitor take-related impacts in terms of individuals. Beach habitat alteration that occurs through excavation and placement of 1.3 MCY of sand, and the associated equipment and personnel needed to complete this activity, will directly and indirectly cause the anticipated incidental take of plovers within the bounds of the identified 3.1 linear mi of beach habitat.

The 3.1 linear mi of beach habitat includes the 1.2 mi section of the renourishment area and the 1.8 mi sand excavation area from building V-10 to the northern extent of the sand excavation area and a 0.1 linear mi section of the renourishment area in front of camera stand Z-100, all areas are bordered on the east and west by MLW and the secondary dune, respectively (Figure 9). The 3.1 linear mi of beach habitat sets a clear, enforceable standard, and beach habitat alteration related to backpassing and renourishment activities outside of that specific area exceeds take. The anticipated take is described in Table 9.

Recreational Beach Use – Linear miles of beach habitat where plovers nest and forage is being used as a surrogate to express the extent of authorized take for the plover related to recreational use activities, particularly operation of ORVs, because it is not practical to monitor take-related impacts in terms of individuals. Beach habitat alteration that occurs through foot traffic and vehicle use recreational beach use will directly and indirectly cause the anticipated incidental take of plovers within the bounds of the identified 1 linear mi of beach habitat.

The 1 linear mi of beach habitat is bounded to the south by the northern extent of the sea wall and extends 1 mi north to the plover closure area bordered on the east and west by MLW and the secondary dune, respectively (Figure 10). The 1 linear mi of beach habitat sets a clear, enforceable standard, and beach habitat alteration related to recreational use activities outside of that specific area exceeds take. The anticipated take is described in Table 9.

Rocket Launches and Flights – The number of launches and flights per year is being used as a surrogate to express the extent of authorized take for the plover related to ongoing operations, including rocket launches, UAVs, piloted aircraft, and launch-related activities immediately adjacent to the beach, because it is not practical to monitor take-related impacts in terms of individuals. The noise, vibration, and exhaust that occurs as a result of the launches or flights will directly and indirectly cause the anticipated incidental take of plovers because the effects, although short-term, can be severe enough to kill individuals.

The 121 launches per year includes liquid fueled ELVs, solid fueled ELVs, sounding rockets, sounding rocket static fires, and drone target launches and incorporates a 10% buffer. The 71,500 flights per year includes UAS and piloted aircraft flights with a 10% buffer. Launches take place at Pads 0-A, 0-B, 1, 2, and the south UAS airstrip flat pad. Flights take place at Wallops Main Base, South Wallops Island, North Wallops Island, and adjacent air space. The locations for each specific action and frequency of each launch are detailed in Table 1. The 121 launches per year and 71,500 flights per year (as detailed in Table 1) set a clear, enforceable standard, and additional launches or flights exceeds take. The anticipated take is described in Table 9.

Knot – Numeric Estimate of Anticipated Incidental Take

Backpassing – Incidental take was calculated using average knot flock size estimates from 2012-2018 on Wallops Island. From 2012-2018 average flock size was 180 adults. Knots have been documented using 1.5 linear mi on Wallops Island for foraging. All of this habitat will be completely removed by sand excavation, which includes operation of heavy equipment (day and night) and presence of additional personnel, and will not return to its current habitat quality and quantity for 6 years, rendering the habitat unavailable or suboptimal. The Service expects all knots in an average flock will be incidentally taken for 1 year following sand excavation (180 adults x 1 year = 180 adults), the following 2 years 50% of an average flock will be incidentally taken due to suboptimal habitat conditions ([180 adults/2] x 2 years = 180 adults). No take is anticipated in the last 3 years due to gradual return of habitat. As backpassing, which includes operation of heavy equipment (day and night) and presence of additional personnel, is anticipated to occur again in 10 years the Service expects a total of 720 knots ([180 adults + 180 adults] x 2 = 720) to be incidentally taken during the 15-year Opinion timeframe. The anticipated take is described in Table 9.

Rocket Launches and Flights – Incidental take of 2 adult knots per year is anticipated from the effects of launch-related activities immediately adjacent to the beach, resulting from intense sound, exposure to rocket exhaust and contaminants, collision with aircraft, and similar launch activities. Over the 15-year Opinion timeframe, the Service expects 30 adult knots to be incidentally taken due to rocket launches and flights. The anticipated take is described in Table 9.

Knot – Surrogate for Monitoring Take

It is not practical to monitor take-related impacts in terms of individual knots for the following reasons: the species has a small body size making it difficult to locate, which makes encountering dead or harmed individuals unlikely; species losses may be masked by annual fluctuations in numbers; take may occur offsite; failure to reproduce or a decrease in nesting productivity may not be detected; the form of take is a non-lethal harm that is not detectable; finding a dead or impaired individual or quantifying a decrease in nesting productivity in the Arctic breeding area attributable to the action is unlikely; since individuals may move to other locations in an attempt to forage, quantifying exactly how many individuals have been impacted is not realistic.

Backpassing – Linear miles of beach habitat where knots forage is being used as a surrogate to express the extent of authorized take for the knot related to backpassing activities, which includes operation of heavy equipment (day and night) and presence of additional personnel, because it is not practical to monitor take-related impacts in terms of individuals. Beach habitat alteration that occurs through excavation of 1.3 MCY of sand, and the associated equipment and personnel needed to complete this activity, will directly and indirectly cause the anticipated incidental take of knots within the bounds of the identified 1.5 linear mi of beach habitat.

The 1.5 linear mi of beach habitat includes the portion of Wallops Island that will be excavated from building V-100 to the northern extent of the sand excavation area bordered on the east and west by MLW and the secondary dune (Figure 9). The 1.5 linear mi of beach habitat sets a clear, enforceable standard, and beach habitat alteration related to backpassing activities outside of that specific area exceeds take. The anticipated take is described in Table 9.

Rocket Launches and Flights – The number of launches and flights per year is being used as a surrogate to express the extent of authorized take for the knot related to ongoing operations, including rocket launches, UAVs, piloted aircraft, and launch-related activities immediately adjacent to the beach, because it is not practical to monitor take-related impacts in terms of individuals. The noise, vibration, and exhaust that occurs as a result of the launches or flights will directly and indirectly cause the anticipated incidental take of knots because the effects, although short-term, can be severe enough to kill individuals.

The 121 launches per year includes liquid fueled ELVs, solid fueled ELVs, sounding rockets, sounding rocket static fires, and drone target launches and incorporates a 10% buffer. The 71,500 flights per year includes UAS and piloted aircraft flights with a 10% buffer. Launches take place at Pads 0-A, 0-B, 1, 2, and the south UAS airstrip flat pad. Flights take place at Wallops Main Base, South Wallops Island, North Wallops Island, and adjacent air space. The locations for each specific action and frequency of each launch are detailed in Table 1. The 121 launches per year and 71,500 flights per year (as detailed in Table 1) set a clear, enforceable standard, and additional launches or flights exceeds take. The anticipated take is described in Table 9.

Loggerhead – Numeric Estimate of Anticipated Incidental Take

Backpassing and Renourishment – Incidental take was calculated using loggerhead nesting activity within the Action Area from 1974-2017 (Table 5). The interval of 5 years was selected based on the infrequent nesting exhibited on Wallops Island (Table 6). Incidental take of 1 adult loggerhead and 1 nest (128 hatchling turtles or eggs) is anticipated every 5 years from the effects of backpassing and renourishment activities, resulting from habitat removal and alteration, equipment staging, sand stockpiling, and operation of heavy equipment (day and night). Over the 15-year Opinion timeframe, the Service expects 3 adults and 384 hatchlings or eggs to be incidentally taken due to backpassing and renourishment activities. The anticipated take is described in Table 9.

Rocket Launches – Incidental take of 1 adult loggerhead and 1 nest (128 hatchling turtles or eggs) is anticipated every 5 years from the effects of launches and launch-related activities immediately adjacent to the beach, resulting from lighting, vibration, intense sound, and exposure to rocket exhaust and contaminants. Over the 15-year Opinion timeframe, the Service expects 3 adults and 384 hatchlings or eggs to be incidentally taken due to rocket launches. The anticipated take is described in Table 9.

Loggerhead – Surrogate for Monitoring Take

It is not practical to monitor take-related impacts in terms of individual loggerheads for the following reasons: harmed females may return to the water which makes encountering dead or harmed individuals unlikely; species losses may be masked by annual fluctuations in numbers; take may occur offsite; failure to reproduce or a decrease in nesting productivity may not be detected if an individual moves to a neighboring island to nest or fails to nest; the form of take is a non-lethal harm that is not detectable; vulnerable hatchlings may be eaten by predators before detection.

<u>Backpassing and Renourishment</u> – Linear miles of beach habitat where loggerheads nests is being used as a surrogate to express the extent of authorized take for the loggerhead related to backpassing and renourishment activities, including operation of heavy equipment (day and night), because it is not practical to monitor take-related impacts in terms of individuals. Beach habitat alteration that occurs through excavation and placement of 1.3 MCY of sand, and the associated equipment and personnel needed to complete this activity, will directly and indirectly cause the anticipated incidental take of loggerheads within the bounds of the identified 5.5 linear mi of beach habitat.

The 5.5 linear mi of beach habitat includes the 1.8 mi sand excavation area and the 3.7 mi of beach habitat where sand will be placed. This beach habitat begins 1,500 ft north of the Wallops Island-Assawoman Island property boundary and extends north to the northern extent of the sand mining area bordered on the east and west by MLW and the secondary dune, respectively (Figure 9). The 5.5 linear mi of beach habitat sets a clear, enforceable standard, and beach habitat alteration related to backpassing and renourishment activities outside of that specific area exceeds take. The anticipated take is described in Table 9.

<u>Rocket Launches</u> – The number of launches per year is being used as a surrogate to express the extent of authorized take for the loggerhead related to ongoing operations, including rocket launches, and launch-related activities immediately adjacent to the beach, because it is not practical to monitor take-related impacts in terms of individuals. The noise, vibration, and exhaust that occurs as a result of the launches will directly and indirectly cause the anticipated incidental take of loggerheads because the effects, although short-term, can be severe enough to kill individuals.

The 121 launches per year includes liquid fueled ELVs, solid fueled ELVs, sounding rockets, sounding rocket static fires, and drone target launches and incorporates a 10% buffer. Launches take place at Pads 0-A, 0-B, 1, 2, and the south UAS airstrip flat pad. The locations for each specific action and frequency of each launch are detailed in Table 1. The 121 launches per year (as detailed in Table 1) set a clear, enforceable standard, and additional launches exceeds take. The anticipated take is described in Table 9.

Table 9. Amount and type of anticipated incidental take.

Species	Amount of Take Anticipated (surrogate)	Initial Amount of Take Anticipated (individuals)	Frequency of Take	Duration of Biological Opinion	Total Amount of Anticipated Take (individuals)	Life Stage when Take is Anticipated	Type of Take	Take is Anticipated as a Result of
Plover	3.1 linear miles of beach habitat alteration (backpassing and renourishment; renourishment from offshore shoal)	20 adults and 9 chicks (backpassing and renourishment)	2 times during Opinion term	15 years	40 adults and 18 chicks	Adults, Chicks	Harm, Kill	• Loss of nesting and foraging habitat due to sand mining. • Reduced reproduction and feeding associated with noise, loss of prey species, and loss or alteration of habitat due to compaction and removal. • Direct effects to individuals and loss of prey species due to contaminants. • Increased vulnerability to predators. • Additional energy expenditure seeking available habitat elsewhere.
		4 adults and 1 chick (renourishment from offshore shoal)	6 times during Opinion term	15 years	24 adults and 6 chicks	Adults, Chicks	Harm, Kill	• Reduced reproduction and feeding associated with noise, loss of prey species, and loss or alteration of habitat due to compaction and removal. • Direct effects to individuals and loss of prey species due to contaminants. • Increased vulnerability to predators. • Additional energy expenditure seeking available habitat elsewhere.
Plover	121 launches/year and 71,500 flights/year (rocket launches and flights)	2 adults and 1 chick or 4 eggs	every year	15 years	30 adults and 15 chicks or 60 eggs	Adults, Chicks, Eggs	Harm, Kill	• Deafening of individuals due to noise generation, causing disorientation, impairment of normal behaviors, increased vulnerability to predators, and physiological stress. • Collision with aircraft. • Noise generation interrupting feeding and sheltering, causing birds to flush from nest resulting in predation or abandonment of eggs/chicks and additional energy expenditure by adults. • Vibration disturbing individuals causing normal behavior to temporarily cease and decreasing egg viability. • Direct exhaust exposure, causing death. • Lighting attracting migrating individuals, causing diversion of flight and increased collision risk.
Plover	1 linear mile of beach habitat alteration (recreational beach use)	2 adults and 1 chick	every year	15 years	30 adults and 15 chicks	Adults, Chicks	Harm, Kill	• Vehicle use on recreational beach can crush chicks and young plovers outside of closed plover nesting area and cause adults to abandon nests.
Knot	1.5 linear miles of beach habitat alteration	360 adults	2 times during Opinion term	15 years	720 adults	Adults	Harm	• Loss of foraging habitat due to sand mining. • Reduced reproduction (due to lack of weight gain) and feeding associated with noise, loss of prey

	(backpassing)							species, and loss or alteration of habitat due to compaction and removal. ● Direct effects to individuals and loss of prey species due to contaminants. ● Increased vulnerability to predators. ● Additional energy expenditure seeking available habitat elsewhere.
Knot	121 launches/year and 71,500 flights/year (rocket launches and flights)	2 adults	every year	15 years	30 adults	Adults	Harm, Kill	● Deafening of individuals due to noise generation, causing disorientation, impairment of normal behaviors, increased vulnerability to predators, and physiological stress. ● Collision with aircraft. ● Noise generation interrupting feeding and sheltering. ● Lighting attracting migrating individuals, causing diversion of flight and increased collision risk.
Loggerhead	5.5 linear miles of beach habitat alteration (backpassing and renourishment; renourishment from offshore shoal)	1 adult and 128 hatchlings or eggs	every 5 years	15 years	3 adults and 384 hatchlings or eggs	Adults, Hatchlings, Eggs	Harm, Kill	● Compaction of sand by equipment. ● Injure or crush nesting females and hatchlings. ● Loss of nesting habitat due to sand excavation and renourishment. ● Females deterred from nesting by staged equipment and sand stockpile.
Loggerhead	121 launches/year (rocket launches)	1 adult and 128 hatchlings or eggs	every 5 years	15 years	3 adults and 384 eggs or hatchlings	Adults, Hatchlings, Eggs	Harm, Kill	● Deafening of individuals due to noise generation, causing disorientation, impairment of normal behaviors, increased vulnerability to predators, and physiological stress. ● Vibration disturbing individuals causing normal behavior to temporarily cease and decreasing egg viability. ● Lighting causing disorientation of hatchlings and behavioral effects on nesting adults.

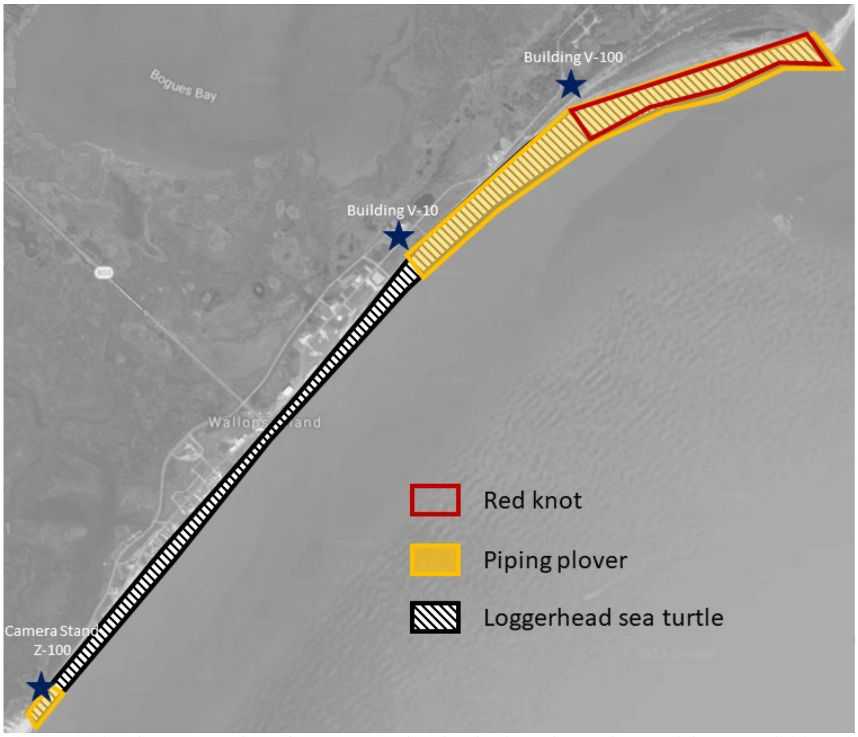

Figure 9. Visual representation of surrogates related to backpassing and renourishment activities with building and camera stand locations represented by blue stars.

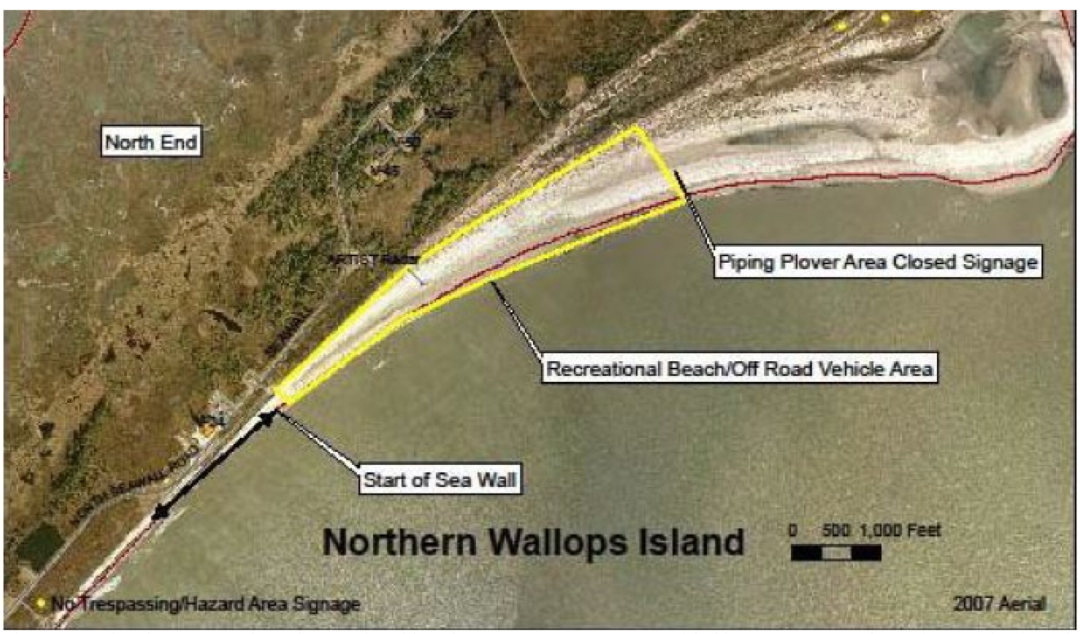

Figure 10. Visual representation of recreational beach surrogate area. Map provided in 2019 Protected Species Monitoring Plan (NASA 2019).

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take of plovers, knots, and loggerheads.

1. Provide information to individuals involved in project construction on how to avoid and minimize effects to plovers, knots, and loggerheads.

2. Actively manage habitats and human activity to avoid and minimize impacts to plovers, knots, and loggerheads.

3. Monitor the effects of the proposed action on plovers, knots, and loggerheads.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of Section 9 of the ESA, NASA must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are nondiscretionary.

1. Prior to initiation of on-site work, notify all prospective employees, operators, and contractors about the presence and biology of the plover, knot, and loggerhead; special provisions necessary to protect these species; activities that may affect these species; and ways to avoid and minimize these effects. This information can be obtained by reading species-related information in this Opinion or a fact sheet containing this information can be created and provided by NASA.

2. Minimize foot traffic throughout beach habitat during construction.

3. Inspect all vehicles for leaks immediately prior to work in beach habitat. Repair any leaks and clean construction vehicles thoroughly to remove any residual dirt, mud, debris, grease, motor oil, hydraulic fluid, coolant, or other hazardous substances from construction vehicles. Inspections, repairs, cleaning, and/or servicing will be conducted either before the vehicle, equipment, or machinery is transported into the field or at the work site within the staging area. All wash-water runoff and/or harmful materials will be appropriately controlled to prevent entry into the beach habitat, including the dune area.

4. Develop a training and familiarization program for all security personnel conducting patrols in areas where listed species may occur. This training program shall include basic biological information about all listed species and be sufficient to allow personnel to tentatively identify the species and its likely habitat to allow them to incorporate appropriate avoidance and minimization measures into their activities.

MONITORING AND REPORTING REQUIREMENTS

1. Notify the Service regarding the projected and actual start dates, progress, and completion of the project and verify that the 5.4 miles of beach habitat alteration was not exceeded and all conservation measures were followed. Provide a report containing this information by December 31 of each year throughout the 15-year duration of this Opinion to the Virginia Field Office at emily_argo@fws.gov.

2. Provide an annual report summarizing the survey and monitoring efforts, location and status of all occurrences of listed species recorded, and any additional relevant information to the Service in digital format, at the email address provided below by December 31 of each year throughout the 15-year duration of this Opinion.

3. Following launches of rockets, conduct surveys for injured, dead, or impaired plovers, knots, and loggerheads. These surveys must be conducted as soon as safety permits following launches. The survey protocols are outlined in the WFF protected Species Management Plan. Post-launch beach surveys will be conducted between March 15 and November 30 of every year to coincide with plover and loggerhead nesting seasons. The survey area will include the beach within 1,000 ft, to the north and south, of the respective launch pad for sounding and orbital-class ELV rocket launches. Provide reports of survey results to the Service in digital format, at the email address below, within 15 business days of each launch event.

4. Care must be taken in handling any dead specimens of proposed or listed species to preserve biological material in the best possible state. In conjunction with the preservation of any dead specimens, the finder has the responsibility to ensure that evidence intrinsic to determining the cause of death of the specimen is not unnecessarily disturbed. The finding of dead specimens does not imply enforcement proceedings pursuant to the ESA. The reporting of dead specimens is required to enable the Service to determine if take is reached or exceeded and to ensure that the terms and conditions are appropriate and effective. Upon locating a dead specimen, notify the Service's Virginia Law Enforcement Office at 804-771-2883 and the Service's Virginia Field Office at the phone number provided below or at 804-693-6694.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

1. Fund demographic studies to evaluate project impacts to plovers and knots on Wallops Island and surrounding islands along Virginia's Eastern Shore.

2. Invest in habitat mapping to better understand changes in available nesting and foraging habitat to plovers and knots along Virginia's Eastern Shore.

3. Support habitat restoration efforts for plovers and knots.

4. Work with resource managers in the surrounding area by participating in monitoring and data collection efforts as well as partnerships to ensure species and habitats on Wallops Island are actively incorporated in efforts to improve our understanding of the dynamics of nesting shorebirds and other species along Virginia's Eastern Shore.

5. Develop an integrated habitat conservation and management plan for Wallops Island. Due to the significance of the area for the conservation of migratory birds and other species, nearly all habitats that occur on WFF provide value to these species. Active efforts to manage habitat, including activities such as control of non-native invasive plants, may significantly improve the value of these areas as habitat.

6. Collect data on the characteristics of beaches and habitat where sea turtle nests and plover nests occur and share this information with the Service, VDGIF and area resource managers, and work with other interested parties to develop protocols for data collection and analysis throughout Virginia to improve our understanding of plover and sea turtle habitat characteristics.

7. Transition security from frequent roving patrols to a closed circuit television system to minimize beach access to the maximum extent practicable.

For the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation on the actions outlined in the reinitiation request. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

If you have any questions regarding this Opinion, or our shared responsibilities under the ESA, please contact Emily Argo of this office at (804) 824-2405, or via email at emily_argo@fws.gov.

Sincerely,

Date: 2019.06.07 10:29:13 -04'00'

Cindy Schulz
Field Supervisor
Virginia Ecological Services

Enclosures

cc: Corps, Norfolk, VA (Attn: Tom Walker)
Corps, Norfolk, VA (Attn: Teri Nadal)
FAA, Washington, D.C. (Attn: Daniel Czelusniak)
Service, Chincoteague Island, VA (Attn: Kevin Holcomb)
Service, Chincoteague Island, VA (Attn: Nancy Finley)
VDGIF, Richmond, VA (Attn: Ernie Aschenbach)
VDGIF, Machipongo, VA (Attn: Ruth Boettcher)
VDNH, Richmond, VA (Attn: Rene Hypes)

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CONSULTATION HISTORY

05-10-2010 The Service issued NASA a non-jeopardy 2010 Opinion for expansion of WFF and ongoing operations (Service 2010a).

07-30-2010 The Service issued NASA a non-jeopardy programmatic 2010 Opinion on the SRIPP (Service 2010b).

09-22-2011 The Service provided concurrence on NASA's no effect determination for construction of a UAS airstrip at the northern portion of the island. The Service provided a not likely to adversely affect determination for several species associated with the operation of the new airstrip.

9-11-2014 The Service provided concurrence on the Navy's not likely to adversely affect determinations for installation and operation of a 5-inch powder gun and electromagnetic railgun at WFF.

11-20-2014 The Service provided concurrence on NASA's not likely to adversely affect determination for relocation of the 50k sounding rocket launcher and construction of a new flat pad to support sounding rocket launches.

08-18-2015 The Service received NASA's request to reinitiate formal consultation on the 2010 Opinions (Service 2010a, 2010b).

09-28-2015 The Service acknowledged receipt of NASA's request to initiate formal consultation.

10-16-2015 A Service biologist conducted a site visit of the project areas.

12-22-2015 The Service provided NASA our non-jeopardy 2015 Opinion (Service 2015c).

01-20-2016 The Service received NASA's request for revisions to the 2015 Opinion.

06-22-2016 The Service provided NASA our revised non-jeopardy 2016 Opinion (Service 2016).

12-12-2017 The Service received an email from NASA indicating the addition of breakwaters in the nearshore environment.

09-28-2018 The Service received a request for concurrence from NASA that increasing the volume of sand to be excavated from Wallops Island and the addition of nearshore breakwaters were covered by the 2016 Opinion.

10-02-2018 to
12-13-2018 The Service and NASA exchanged emails and phone calls regarding scope of work, information needs, and reinitiation.

12-14-2018 The Service received NASA's request for reinitiation of the 2016 Opinion.

12-22-2018 to
01-25-2019 Due to a lapse in appropriations Service employees were furloughed and not authorized to work on this consultation.

12-17-2018 to
03-19-2019 The Service and NASA exchange emails and phone calls regarding project details, timeframe of consultation, and monitoring requests.

03-20-2019 The Service acknowledged receipt of NASA's request to reinitiate formal consultation.

03-29-2019 The Service attended a stakeholder meeting at NASA WFF with representatives from the Virginia Department of Conservation and Recreation, VDGIF, CNWR, and Corps.

04-03-2019 to
05-08-2019 The Service and NASA exchanged emails regarding project details.

APPENDIX A

Table 7. Analysis of effects of reinitiated actions on plover, knot, and loggerhead.

Construction Activity	Environmental Impact or Threat	Stressors	Stressor Pathway	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Avoidance and Minimization Measures	Comments
Piping Plover										
dune plantings in renourishment area	neutral	none	n/a	n/a	n/a	n/a	n/a	NE	Plants will be installed between October 1 and March 31 of any given year.	Planting will occur along newly created dunes.
equipment staging	neutral	none	n/a	n/a	n/a	n/a	n/a	NE	Establish upland areas for equipment and material staging – to be discussed with contractor (potentially daily).	Equipment will not be staged in areas used by plovers/plover habitat.
sand stockpile	neutral	none	n/a	n/a	n/a	n/a	n/a	NE	none	Sand will not be stockpiled in areas used by plovers/plover habitat.
operation of equipment (day and night)	habitat degradation; reduction in prey population; disturbance	compaction of habitat; chemical contaminants; loss of prey; altered flight path; nest abandonment; increased predation; increased vehicular traffic on adjacent roadway	driving through habitat; release of small amounts of fuel, oil, lubricants, and other contaminants; equipment noise	nesting and foraging habitats; prey; population; individuals (adults and chicks)	decreased reproduction; harm	breeding; feeding; sheltering	reproduction, numbers	LAA	Sand harvesting will not begin until after the last plover chick has fledged, and will continue until 1.3 MCY of sand has been harvested. Starting March 15 of any year, a biological monitor will conduct a daily survey of the whole of Wallops Island beach for nesting plovers. Any nests discovered would be immediately exclosed and geolocated. The biological monitor will coordinate directly with onsite project personnel to ensure they are aware of nesting status.	Even with the application of avoidance and minimization measures, sand compaction by equipment may cause burial and suffocation of invertebrate prey species, resulting in loss of available prey. The habitat may be degraded due to sand compaction, making it difficult for birds to access prey and/or causing a loss of available prey. Individuals are expected to cease normal foraging and seek available habitat elsewhere. Searching for alternative suitable habitat leads to increased energy expenditure from additional search times and increased exposure to predators. Expending additional energy searching for and reaching suboptimal habitat that may have limited food resources does not allow plovers to maintain

									Work activities will be suspended within 1,000 ft of the nest until plover chicks have fledged.	optimal body condition, resulting in decreased nest productivity or inability to nest. The use of suboptimal habitat may lead to nesting on less suitable habitat, such as on a narrower beach more vulnerable to flooding, and decreased nest or brood attendance by adults could increase predation of nests and/or chicks. If the habitat is less suitable foraging opportunities may be limited and decrease chick survival. If birds seek nesting habitats elsewhere, they will also face competition for territories with birds already established there, potentially leading to lower productivity and possibly adult survival from reduced food availability. Operation of equipment may result in releases of small amounts of fuel, oil, lubricants, and other contaminants. While we do not expect contaminant releases to occur frequently, these substances may adhere to feathers, which would impact the bird's ability to move or result in contaminant ingestion from preening, harming the birds. Contaminant releases could also result in impairment or death of prey species reducing prey availability and quality, causing the birds to spend additional time foraging increasing the time they are vulnerable to predators. Both nesting and migratory plovers occur in the Action Area and would be impacted as described above. A 1,000 ft buffer will be placed around each known nest location, likely

										encompassing the foraging area of any adults and chicks from the buffered nest. Plovers foraging outside the 1,000 ft buffer will be disturbed by equipment noise. Individuals are expected to cease normal foraging, nesting, or flight behavior. They may alter their flight path, seek available habitat elsewhere and/or abandon nesting attempts, all of which expends additional energy and increases their vulnerability to predators as discussed above.
presence of additional personnel	increased human activity/disturbance	nest abandonment; increased predation	human presence and noise	population; individual	decreased reproduction; harm	feeding; breeding; sheltering	reproduction; numbers	LAA	Work activities will be suspended within 1,000 ft of the nest until plover chicks have fledged.	A 1,000 ft buffer will be placed around each known nest location, likely encompassing the foraging area of any adults and chicks from the buffered nest. Plovers foraging outside the 1,000 ft buffer will be disturbed by noise. Noise may discourage use of habitat causing adults to abandon nesting attempts or migratory plovers to leave the area. This will cause plovers to expend additional energy seeking available habitat elsewhere. The effects of this have been discussed in the operation of equipment row.
sand excavation	habitat degradation	altered habitat; loss of prey; increased predation	removal of occupied nesting habitat; removal of occupied foraging habitat; prey removal	prey, habitat, population, individuals	harm; kill	breeding; feeding; sheltering	reproduction; numbers; distribution	LAA	Sand harvesting will not begin until after the last plover chick has fledged and will continue until 1.3 MCY of sand has been harvested. Starting March 15 of any year, a biological monitor will conduct a daily survey of the whole of Wallops Island beach for nesting plovers. Any nests	Sand excavation will not begin until after chicks from 2019 nests have fledged. However, removal of nesting habitat will result in lack of nesting and/or adults expending additional energy seeking available habitat elsewhere. The effects of this have been discussed in the operation of equipment row. After sand excavation, the remaining beach would be much narrower, have

									discovered would be immediately exclosed and geolocated. The biological monitor will coordinate directly with onsite project personnel to ensure they are aware of nesting status. Work activities will be suspended within 1,000 ft of the nest until plover chicks have fledged.	a steeper initial profile, be more vegetated, and have different physical properties (e.g., sand grain characteristics, drainage). This profile would be unsuitable for plover foraging, reducing overall carrying capacity for breeding plovers. Sand removal would result in impairment or death of prey species and these invertebrate food sources may take multiple seasons to recover to pre sand excavation levels. We expect that beach habitat will be unsuitable for plovers for at least 2 consecutive nesting seasons following sand excavation. Return of previous beach topography that provided foraging and nesting habitat is expected to take up to 6 years to return to its current habitat quality and quantity.
renourishment	temporary loss of nesting habitat, temporary loss of foraging habitat	altered habitat; loss of prey	change in nesting habitat quality; burial of prey species	prey; habitat; individuals	harm	breeding; feeding	reproduction; numbers; distribution	LAA	Starting March 15 of any year, a biological monitor will conduct a daily survey of the whole of Wallops Island beach for nesting plovers. Any nests discovered would be immediately exclosed and geolocated. The biological monitor will coordinate directly with onsite project personnel to ensure they are aware of nesting status. Work activities will be suspended within 1,000 ft	The northernmost portion of the renourishment area provides nesting and foraging habitat, while a small section at the southern end provides foraging habitat. Placement of sand would result in the burial of prey species. Following sand placement, the suitability of the renourished beach as foraging habitat for migrating plovers is expected to be reduced due to loss of invertebrate prey. The reduced habitat suitability will result in plovers expending additional energy seeking available habitat elsewhere. The effects of additional energy expenditure have been discussed in the operation of equipment row.

									of the nest until plover chicks have fledged.	Compaction of the sand is expected to occur as a result of the use of heavy equipment during renourishment. The amount of equipment use and the associated degree of compaction is unknown, but due to the need to contour the beach to design specifications, compaction is expected to occur. This would result in changes in beach topography that reduce habitat quality for nesting plovers. Loss of nesting habitat will result in lack of nesting and/or adults expending additional energy seeking available habitat elsewhere, the effects of which have been discussed in the operation of equipment row. We expect that beach habitat will be unsuitable for plover foraging for 1 year following renourishment.
breakwater construction	disturbance	nest abandonment ; increased predation	noise	population; individual (all life stages)	annoyed to decreased reproduction; harm	breeding; feeding; sheltering	reproduction; numbers; distribution	LAA	none	Breakwaters will be constructed in the nearshore environment and the associated noise would discourage use of habitat causing adults to abandon nests or nesting attempts. This will result in lack of nesting and/or adults expending additional energy seeking available habitat elsewhere, the effects of which have been discussed in the operation of equipment row. The breakwaters would change the beach topography, causing tombolos to form and reducing the rate of recovery of the nesting and foraging habitat. The effects of the reduced rate of recovery on plovers has been discussed in the sand excavation row.

Red Knot										
Construction Activity	Environmental Impact or Threat	Stressors	Stressor Pathway	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Avoidance and Minimization Measures	Comments
dune plantings in renourishment area	neutral	none	n/a	n/a	n/a	n/a	n/a	NE	Plants will be installed between October 1 and March 31 of any given year.	Planting will not take place in areas used by knots/knot habitat.
equipment staging	neutral	none	n/a	n/a	n/a	n/a	n/a	NE	Establish upland areas for equipment and material staging – to be discussed with contractor (potentially daily).	Equipment will not be staged in areas used by knot/knot habitats.
sand stockpile	neutral	none	n/a	n/a	n/a	n/a	n/a	NE	none	Sand will not be stockpiled in areas used by knots/knot habitat.
renourishment	temporary loss of foraging habitat	altered habitat; loss of prey	change in nesting habitat quality; burial of prey species	prey; habitat; individuals	harm	breeding; feeding	reproduction; numbers; distribution	NLAA	Starting March 15 of any year, a biological monitor will conduct a daily survey of the whole of Wallops Island beach for nesting plovers and loggerheads. Any nests discovered would be immediately exclosed and geolocated. The biological monitor will coordinate directly with onsite project personnel to ensure they are aware of nesting status. Work activities will be suspended within 1,000 ft of the nest until plover	Since sand will not be placed in habitat used for knot foraging, this activity is not likely to adversely affect foraging knots.

									chicks have fledged and/or loggerheads have hatched.	
operation of equipment (day and night)	habitat degradation; physical impacts to individuals; reduction in prey population; disturbance	compaction of habitat; chemical contaminants; loss of prey; altered flight path; increased predation; increased vehicular traffic on adjacent roadway	release of small amounts of fuel, oil, lubricants, and other contaminants; equipment noise	foraging habitats; prey; population; individuals (all life stages)	harm	feeding; sheltering	numbers	LAA	Sand harvesting will not begin until after the last plover chick has fledged or the last loggerhead has hatched, whichever is later, and will continue until 1.3 MCY of sand has been harvested. Starting March 15 of any year, a biological monitor will conduct a daily survey of the whole of Wallops Island beach for nesting plovers and loggerheads. Any nests discovered would be immediately exclosed and geolocated. The biological monitor will coordinate directly with onsite project personnel to ensure they are aware of nesting status. Work activities will be suspended within 1,000 ft of the nest until plover chicks have fledged and/or loggerheads have hatched.	While activities will not be conducted within 1,000 ft of documented plover or turtle nests, which may overlap with areas used by knots, knots foraging outside the 1,000 ft buffer will be disturbed by equipment noise. Individuals are expected to cease normal foraging or flight behavior. They may alter their flight path or seek available habitat elsewhere. Searching for alternative suitable habitat leads to increased energy expenditure from additional search times and increases exposure to predators. Use of suboptimal habitat may also result in lower weight when reaching the Arctic leading to reduced reproductive success. Even with the application of avoidance and minimization measures, sand compaction by equipment may cause burial and suffocation of invertebrate prey species, resulting in loss of available prey. The habitat may be degraded due to sand compaction, making it difficult for birds to access prey and/or causing a loss of available prey. Individuals are expected to cease normal foraging and seek available habitat elsewhere, the effects of which are discussed above. Operation of equipment may result in releases of small amounts of fuel, oil, lubricants, and other contaminants. While we do not expect contaminant

										releases to occur frequently, these substances may adhere to feathers, which would impact the bird's ability to move or result in contaminant ingestion from preening, harming the birds. Contaminant releases could also result in impairment or death of prey species reducing prey availability and quality, causing the birds to spend additional time foraging increasing the time they are vulnerable to predators.
presence of additional personnel	increased human activity/disturbance	altered flight path; increased predation	human presence and noise	population; individuals	harm	feeding; breeding; sheltering	reproduction; numbers	LAA	Work activities will be suspended within 1,000 ft of the nest until chicks have fledged and/or loggerheads have hatched.	While activities will not be conducted within 1,000 ft of documented plover or turtle nests, which may overlap with areas used my knots, knots foraging outside the 1,000 ft buffer will be disturbed by noise. Noise may discourage use of habitat causing adults to abandon foraging or migratory knots to leave the area. This will cause knots to expend additional energy seeking available habitat elsewhere. The effects of additional energy expenditure on knots has been discussed in the operation of equipment row.
sand excavation	habitat degradation	altered habitat; loss of prey; increased predation	removal of occupied foraging habitat; prey removal	prey, habitat, population, individuals	harm	feeding; sheltering	numbers; distribution	LAA	Sand harvesting will not begin until after the last plover chick has fledged or the last loggerhead has hatched, whichever is later, and will continue until 1.3 MCY of sand has been harvested. Starting March 15 of any year, a biological monitor will conduct a daily survey of the whole of Wallops	After sand excavation, the remaining beach would have a steeper initial profile, be more vegetated, and have different physical properties (e.g., sand grain characteristics, drainage). This profile would be unsuitable for knot foraging. Sand excavation would result in impairment or death of prey species and these invertebrate food sources may take multiple seasons to recover to pre sand harvesting levels.

									Island beach for nesting plovers and loggerheads. Any nests discovered would be immediately exclosed and geolocated. The biological monitor will coordinate directly with onsite project personnel to ensure they are aware of nesting status. Work activities will be suspended within 1,000 ft of the nest until plover chicks have fledged and/or loggerheads have hatched.	We expect that beach habitat will be unsuitable for knots for at least 2 consecutive seasons following sand excavation. Return of previous beach topography that provided foraging habitat is expected to take up to 6 years to return to its current habitat quality and quantity.
breakwater construction	disturbance	increased predation	noise	population; individual	harm	feeding; sheltering	numbers; distribution	LAA	none	Breakwaters would be constructed in the nearshore environment and the associated noise would discourage use of habitat causing adults expending additional energy seeking available habitat elsewhere. The breakwaters would also change the beach topography, causing tombolos to form and reducing the rate of recovery of the foraging habitat. The reduced habitat suitability will result in knots expending additional energy seeking available habitat elsewhere. The effects of the reduced rate of habitat recovery and additional energy expenditure have been discussed above.
Loggerhead Sea Turtle										

Construction Activity	Environmental Impact or Threat	Stressors	Stressor Pathway	Exposure (Resource Affected)	Range of Response	Conservation Need Affected	Demographic Consequences	NE, NLAA, or LAA	Avoidance and Minimization Measures	Comments
dune plantings in renourishment area	neutral	none	n/a	n/a	n/a	n/a	n/a	NE	Plants will be installed between October 1 and March 31 of any given year.	Plants will not be installed when habitat is actively used by sea turtles and presence of plants will not impact sea turtle during subsequent nesting seasons.
presence of additional personnel	neutral	none	n/a	n/a	n/a	n/a	n/a	NE	Work activities will be suspended within 1,000 ft of the nest until sea turtles have hatched.	Work activities will be taking place a sufficient distance from documented nests to avoid impacts related to foot traffic.
breakwater construction	habitat degradation	change in habitat quality	habitat alteration	population; individual	harm	breeding	reproduction; numbers; distribution	NLAA	none	The breakwaters would change the beach topography, causing tombolos to form and reducing the rate of recovery of the nesting habitat. Little information is available about the impacts of tombolos on nesting sea turtles, but stabilization of beach topography (if not significantly different from the natural topography) may support maintenance of loggerhead nesting habitat following renourishment activities.
equipment staging	habitat degradation	prevention of habitat access; increased predation	equipment blocking access to habitat	individuals (adults, hatchlings)	harm; kill	breeding	reproduction; numbers	LAA	Establish upland areas for equipment and material staging – to be discussed with contractor (potentially daily). Starting March 15 of any year, a biological monitor will conduct a daily survey of the whole of Wallops Island beach for nesting plovers and loggerheads.	Equipment staging areas may be modified daily and may not always be established in an upland area. Any equipment staged on the sand/beach may present an obstacle to nesting loggerheads causing them to return to the ocean instead of nesting or expend additional energy to find a suitable nesting site, resulting in a reduction in nesting success.

									Any nests discovered would be immediately exclosed and geolocated. The biological monitor will coordinate directly with onsite project personnel to ensure they are aware of nesting status. Work activities will be suspended within 1,000 ft of the nest until loggerheads have hatched.	Hatchlings may encounter equipment on the beach at night during hatching if they travel outside of the 1,000 ft buffer, causing them to spend more time reaching the ocean, leaving them vulnerable to predators, which increases the likelihood of harm or death.
sand stockpile	habitat degradation	prevention of habitat access; increased predation	equipment blocking access to habitat	individuals (adults, hatchlings)	harm; kill	breeding	reproduction; numbers	LAA	Work activities will be suspended within 1,000 ft of the nest until loggerheads have hatched	Any sand stockpiled on the beach may present an obstacle to nesting loggerheads causing them to return to the ocean instead of nesting or expend additional energy to find a suitable nesting site, resulting in a reduction in nesting success. Hatchlings may encounter the stockpile on the beach at night during hatching if they travel outside of the 1,000 ft buffer or a nest is laid after the stockpile has been established and, therefore, is within the 1,000 ft buffer. This will cause hatchlings to spend more time reaching the ocean, leaving them vulnerable to predators, which increases the likelihood of harm or death.
operation of equipment (day)	habitat degradation	altered habitat	compaction of habitat	nesting habitats; population; individuals	harm	breeding	reproduction, numbers	LAA	Sand harvesting will not begin until after the last loggerhead has hatched and	Equipment will compact sand, making sand less desirable for nesting loggerheads. Compaction can reduce the ability of females to excavate an

									will continue until 1.3 MCY of sand has been harvested. Starting March 15 of any year, a biological monitor will conduct a daily survey of the whole of Wallops Island beach for nesting loggerheads. Any nests discovered would be immediately exclosed and geolocated. The biological monitor will coordinate directly with onsite project personnel to ensure they are aware of nesting status. Work activities will be suspended within 1,000 ft of the nest until loggerheads have hatched.	egg chamber, resulting in a reduction in nesting success.
operation of equipment (night)	habitat degradation; physical impacts to individuals	prevention of habitat access; compaction of habitat; direct physical impacts; crushing of individuals	blocking access to nesting habitat; compaction of habitat; driving over sea turtles adults and hatchlings	nesting habitats; individuals (hatchlings and adults)	harm; kill	breeding	reproduction; numbers	LAA	Sand harvesting will not begin until after the last loggerhead has hatched and will continue until 1.3 MCY of sand has been harvested. Starting March 15 of any year, a biological monitor will conduct a daily survey of the whole of Wallops Island beach for nesting loggerheads. Any nests discovered would be immediately exclosed and geolocated. The biological monitor will coordinate directly with onsite project	During nesting season, any equipment on the beach may present an obstacle to nesting loggerheads causing them to return to the ocean instead of nesting or to expend additional energy to find an alternate suitable nesting site, resulting in a reduction in nesting success. Hatchlings may be crushed by equipment if they travel beyond the 1,000 ft buffer or encounter ruts left by equipment, causing them to spend more time reaching the ocean, leaving them vulnerable to predators, which increases the likelihood of harm or death. Equipment will compact sand, making sand less desirable for nesting sea turtles by reducing the ability of

									personnel to ensure they are aware of nesting status. Work activities will be suspended within 1,000 ft of the nest until loggerheads have hatched.	females to excavate an egg chamber, resulting in a reduction in nesting success.
sand excavation	habitat degradation	altered habitat	removal of occupied nesting habitat	habitat, population, individuals	harm	breeding	reproduction; numbers; distribution	LAA	Sand harvesting will not begin until after the last loggerhead has hatched and will continue until 1.3 MCY of sand has been harvested. Starting March 15 of any year, a biological monitor will conduct a daily survey of the whole of Wallops Island beach for nesting loggerheads. Any nests discovered would be immediately exclosed and geolocated. The biological monitor will coordinate directly with onsite project personnel to ensure they are aware of nesting status. Work activities will be suspended within 1,000 ft of the nest until loggerheads have hatched.	Removal of nesting habitat may result in lack of nesting or expenditure of additional energy to find a suitable nesting site. We expect that beach habitat in the sand excavation area will be unavailable for loggerheads for at least 2 consecutive nesting seasons following sand excavation. Return of previous beach topography that provided nesting habitat is expected to take up to 6 years to return to its current habitat quality and quantity.
renourishment	temporary loss of nesting habitat	altered habitat	change in nesting habitat quality	habitat; individuals	harm	breeding	reproduction; numbers; distribution	LAA	Starting March 15 of any year, a biological monitor will conduct a daily survey of the whole of Wallops Island beach for nesting loggerheads. Any nests discovered would be immediately exclosed and	Nesting has been documented in the renourishment area and changes in beach topography and sand compaction may reduce habitat quality. The amount of equipment use and the associated degree of compaction is unknown, but due to the need to contour the beach to design

									geolocated. The biological monitor will coordinate directly with onsite project personnel to ensure they are aware of nesting status. Work activities will be suspended within 1,000 ft of the nest until loggerheads have hatched.	specifications, compaction is expected to occur. This would result in changes in beach topography that reduce habitat quality for nesting loggerheads by reducing the ability of females to excavate an egg chamber. Nest failure and reduced rates of hatchling emergence are expected to occur for up to 2 years after sand placement. Directly in front of the riprap protecting the launch pads nesting habitat is not available and renourishment will increase available nesting habitat along this stretch of Wallops Island where nesting has been documented historically.